**DOCTOR OF PHILOSOPHY**

# An analysis of market efficiency in the South Asian emerging stock markets Bangladesh, India, Pakistan and Sri Lanka

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# An analysis of market efficiency in the South Asian emerging stock markets: Bangladesh, India, Pakistan and Sri Lanka

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University of Dundee

# AN ANALYSIS OF MARKET EFFICIENCY IN THE SOUTH ASIAN EMERGING STOCK MARKETS: BANGLADESH, INDIA, PAKISTAN AND SRI LANKA

**MUHAMMAD NIAZ KHAN**

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**This thesis is dedicated to my parents who have supported me all the way since the beginning of my studies. Also this thesis is dedicated to my wife, my daughter (Mahnoor), my son (Muhammad Shayan Khan) and you (the reader).**

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## DECLARATION

I hereby declare that I am the author of this thesis, that the work of which this thesis is a record has been done by myself, and that it has not previously been accepted for a higher degree.

**Signed:________________________** **Dated:____________________**

**Muahmmad Niaz Khan**

## CERTIFICATE

We certify that Muhammad Niaz Khan has worked the equivalent of six semesters on this research, and that the conditions of the relevant ordinance and regulations have been fulfilled.

**Signed:________________________** **Dated:_______________**
**Dr. Suzanne Fifield**

**______________________________** **Dated:_______________**
**Professor David M. Power**

**______________________________** **Dated:_______________**
**Dr. Nongnuch Tantisantiwong**

# ABSTRACT

This thesis investigates the weak-form of the Efficient Market Hypothesis (EMH) in the South Asian region. In particular, the emerging market countries of Bangladesh, India, Pakistan and Sri Lanka are considered. According to the weak-form of the EMH, current share prices reflect all available historical information such that investors should not be able to outperform the market on a consistent basis by trading on past information. It is an important topic for investigation given the economic growth as well as the financial development which have taken place in the region over the last two decades (South Asian Financial Markets Review, 2010). Moreover, most previous studies have investigated the topic for developed or other emerging markets; the South Asian region has largely been ignored. Prior studies which have investigated the South Asian markets have either focused on each country separately, or included one or two countries from the region as part of a broader sample. This thesis tries to fill this gap in the literature by investigating market efficiency in the South Asian markets as a regional grouping.

In the first part of the analysis the long- and short-run relationships among the four stock markets are examined by employing a multivariate cointegration framework, the Vector Error Correction Model (VECM) approach, the Granger Causality test, Impulse Response Function analysis and Variance Decomposition analysis. A large sample of weekly stock index data is used in the analysis covering the 18-year period January 1993 - December, 2010. To analyse the effect of important global events on market integration, the data are split into the two sub-periods of pre- and post-September 11, 2001. The results suggest that linkages exist among the markets in both the long- as well as in the short-run. These findings imply that share price changes may be predicted from historical information not only in the market itself but from the changes in the other three markets as well. In addition, international portfolio diversification into the region

may have limited benefits in the long-run as equity prices in all four countries move together in an equilibrium fashion over the longer run.

In the second empirical analysis, relationship between the equity returns and macroeconomic variables is investigated. The research examines the EMH by investigating whether lagged shocks to macroeconomic variables are important in explaining equity returns. Both local and global macroeconomic variables are used and their importance in predicting the equity returns for each of the region's markets is analysed. In particular, 12 macroeconomic variables were investigated, including seven local and five global measures being employed. Principal Components Analysis (PCA) is used to narrow down the most relevant factors. Principal Components (PCs) are then extracted and used as inputs into regressions explaining future returns. The resulting findings show that local economic factors are important in explaining share returns in the South Asian emerging stock markets. The findings support the notion that historical macroeconomic information may be used to predict share price changes in the regional markets.

Finally, to investigate market linkages in greater depth, the thesis studies volatility and return interactions among the markets simultaneously. A multivariate GARCH-BEKK model is used to investigate return and volatility spillovers in own as well as in cross-markets. Results from the analysis indicated that the four markets of Bangladesh, India, Pakistan and Sri Lanka are linked not only by the news transmission about the share returns but also by the transmission of volatility. The evidence supports the notion that 'news' in one market influences not only the returns in that market but also the variance of price changes in other markets. These findings imply that equity returns in the South Asian stock markets are predictable from historical share price changes in their own, as well as from the other markets of the region; this result calls the weak form of the EMH into question since it suggests that an investor could outperform by studying historic return and volatility data in the region.

# Chapter 1

# Introduction

## 1.1: Introduction

This thesis investigates the efficiency of four South Asian emerging stock markets. It examines the weak-form of the EMH for the stock markets of Bangladesh, India, Pakistan and Sri Lanka. According to this form of the EMH, current share prices reflect all available historical information such that investors should not be able to outperform the market on a consistent basis by trading on past information. Therefore, it implies that past data should not be able to predict current share prices in a regular fashion from past prices. This is an important topic given the economic growth within the region (Devarajan and Nabi, 2006), as well as the financial developments that have occurred in the four countries over the past two decades (South Asian Financial Markets Review, 2010). Moreover, while many studies have examined the topic of stock market efficiency for each country separately, few have adopted a comprehensive perspective and considered the four countries as a regional grouping. This gap in the literature is surprising since all (Bangladesh, India, Pakistan and Sri Lanka) share cultural and historic ties which suggest that linkages may be present[1].

Interactions among the stock markets of Bangladesh, India, Pakistan and Sri Lanka are examined in the current research. Linkages among the stock markets are investigated over long- and short-run time spans, as well as from the perspective of both returns and volatility transmissions among the national equity indices of the region. An analysis of stock market integration in terms of return and volatility can be used to understand whether own or another market's past returns or variances (or covariances) can be used to

[1] This issue is explored in Chapter 2 of the thesis. While recognising that there are similarities between the background, independence and cultures of these countries, Chapter 2 also highlights the differences that exist, and the conflicts that have occurred, between Bangladesh, India, Pakistan and Sri Lanka.

predict current share prices in the four stock markets of South Asia being examined. In addition, inter-relationships between the share returns and various local and global macroeconomic variables are examined to understand whether domestic or international factors can be used to explain share returns in the South Asian region. The question of whether or not the stock exchanges in the South Asian region are weak-form efficient is investigated by studying the inter-dependence among these market's returns as well as any linkages between the performance of these markets and economic variables. In addition, in order to investigate whether linkages among the markets have changed over time and with the occurrence of events of international importance, the whole period investigated in this thesis, from January 1993 to December 2010, is split into two sub-periods (pre- and post-September 2001)[2].

### 1.2: Motivation and Contribution

The South Asian region is of interest for a number of reasons. First, very few studies about linkages among stock markets have focused on this region; most have adopted a different geographical perspective by concentrating on Latin America (Chen et al., 2002), Africa (Wang et al., 2003), Central Europe (Gilmore and McManus, 2002) or other markets of Asia (Click and Plummer, 2005). The two exceptions to this generalisation are Narayan et al. (2004) and Lamba (2005) which have examined the linkages among South Asian markets using daily data for the period 1995-2001 and 1997-2003, respectively. Since 2005, no study has analysed more recent data about the four markets. In addition,

[2] The time period examined for the relationship between the macroeconomic variables is from January 1998 to December 2010 due to the unavailability of data for the period from January 1993.

previous studies which have examined relationship between share returns and macroeconomic variables in South Asian countries are fairly dated and have generally examined each country individually and investigated a relatively small number of variables[3]. For example, Gunasekarage et al. (2004), Ahmed and Imam (2007), Ahmed (2008) and Sohail and Hussain (2009) have studied the relationship between economic variables and stock market performance in Sri Lanka, Bangladesh, India and Pakistan, individually. In addition, all of these studies have examined the relationship between domestic economic variables and share returns, ignoring the influence of international factors on the share returns in these markets[4]. Thus, when the author of this thesis was casting around for a topic to research, this gap in the literature suggested that an up-to-date, regional investigation might yield fruitful insights.

Second, recent investigations such as Li and Majerowska (2008) have argued that volatility should also be investigated when studying interactions among stock markets. For instance, these authors have argued that the average level of equity price changes in one market may not be related to mean returns in other stock exchanges; rather, they suggest that volatility may be transmitted across markets. Therefore, shocks and volatility in one market may spread to other markets depending on the linkages among the various markets even though the mean level of return may remain relatively unaltered. From the previous literature, it is evident that few studies have used multivariate GARCH models

[3] One exception to this generalisation is Smith and Nandha (2003) which included the four countries of Bangladesh, India, Pakistan and Sri Lanka. However, they examined the relationship between stock prices and exchange rates over the period 1995 to 2001. By employing cointegration analysis and granger causality tests they found no long-run relationship between the two variables for all four markets.
[4] In the previous literature, it is evident that both local and international factors are important in explaining share price changes in emerging stock markets (see Chapters 3 and 6 for more details).

to investigate both return and volatility spillovers in own- and cross- markets[5]. Studies employing multivariate GARCH models are scarce in emerging markets in general and in the South Asian region in particular[6]. In the existing literature which has employed multivariate GARCH models, the focus is on developed or other emerging markets. South Asian markets are largely ignored in these studies. Thus, I believed that in addition to a gap in the substantive literature, relatively new, sophisticated econometric techniques had been developed which could address the research questions being examined in a powerful way; the potential of novel insights to emerge from such an examination was a key motivation behind the research in this doctorate.

Third, when conducting this research, I wanted to undertake a comprehensive analysis of the EMH in the South Asian region. According to Hakkio and Rush (1991), the length of time is an important factor in analysing this research question in a comprehensive fashion. In particular, Hakkio and Rush (1991) have highlighted the need to study long-run relationships[7]. In the current thesis, a time period of 18 years is used to investigate the long-run relationship among the markets. Previous studies, such as Yang et al. (2003), have only considered six-and-a-half years of data for India and Pakistan as part of a broader investigation of market integration among 12 markets in Asia[8]. In addition, Elyasiani et al. (1998) only analysed data for India and Sri Lanka when investigating the short-run relationship between Sri Lanka and its major trading partners.

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[5] For more details about these studies the reader is referred to see Chapter 7.

[6] One reason for the shortage of literature in this area is advanced by Li and Majerowska (2008) who argued that although the techniques were introduced earlier, most software applications do not have routine procedures to estimate these models.

[7] They have shown that the power of the trace and maximum eigenvalues is increased with the length of time rather than the data frequency.

[8] Along with India and Pakistan, the markets analysed for integration were Hong Kong, Indonesia, Japan, Korea, Malaysia, the Philippines, Singapore, Thailand, Taiwan and the US using daily data over the period 1995-2001.

Fourth, the South Asian markets examined in this thesis have all adopted liberalisation policies and allowed foreign investors to buy equities in locally listed companies during recent decades. These policies have resulted in a rise in investment across the region and, hence, possibly accelerated trends towards integration. Indeed, a policy promoting harmonisation among stock markets in the region led to the establishment of the South Asian Federation of Exchanges (SAFE) in 2000. As a result of the growing economic and financial ties between Bangladesh, India, Pakistan and Sri Lanka, as well as the common heritage among the countries, integration within the region might have increased. In addition, regional trade among the countries has increased over the recent years as conflicts have subsided and the priority attached to economic growth has increased; hence, economic activities in these four regional markets may have more of an influence on the linkages among share returns in these countries. At the very least, the efficiency of the stock markets in Bangladesh, India, Pakistan, and Sri Lanka may have changed following the adoption liberalisation policies and the influx of foreign investors from developed countries. The need for an up-to-date study which addresses these issues suggested that the current doctoral topic might be worthwhile.

Finally, previous studies have promoted the idea that events of international importance often have an impact on market integration. For example, Arshanapalli and Doukas (1993) have argued that, after the October 1987 crash, the degree of international co-movement among stock prices increased significantly. More recently, Bowman and Comer (2000) found that interdependence among countries' equity markets increased significantly at the time of a major financial crisis. To that end, the analysis in this thesis focuses on the month of September 2001 when the attack on the World Trade Centre in the US may have accelerated the level of integration among the South Asian markets[9]. The event may have accelerated interactions among the South Asian markets due to financial ‘contagion’ where shocks in the developed markets spread across the globe (Wang et al., 2005). Indeed, King and Wadhwani (1990) argued that fundamental variables in individual countries have largely failed to provide an explanation for the international transmission of shocks. Therefore, many researchers have followed King and Wadhwani’s notion that market contagion can explain the response to 9/11. They define contagion as a significant increase in correlation coefficients across global financial markets as a consequence of any sudden, unexpected disturbance. In addition, Charles and Darne (2006) have argued that the US market often behaves as a leader when responding to unusual events and influences other markets of the world; this view supports the argument of heightened linkages among markets during a crisis such as the 9/11 attack on the World Trade Centre.

Linkages among four South Asian emerging stock markets are investigated in the current thesis and these may have implications for the level of pricing efficiency which may be present as well as for the potential for foreign investors to reap the gains from international portfolio diversification in Bangladeshi, Indian, Pakistani or Sri Lankan equities. In particular, the thesis examines these linkages over a long period of time and divides the time frame into two sub-periods to analyse whether these linkages have changed since previous studies were undertaken. In addition, the findings of this thesis will facilitate a comparison with the results about stock markets in other developing as

[9] It is now possible to investigate any such relationship because of the reasonable time period that has elapsed since the incident. Although some studies have attempted to investigate the impact of this event on market integration, they suffer from a short span of data available (for example, Lamba, 2005 used data from 1997 to 2003).

well as developed countries. This thesis will add to the literature about emerging stock markets in the South Asia since relatively little is known about ESMs in this region. The investigation of the region is of interest for a number of compelling reasons. First, the liberalisation policies introduced by these markets, a rise in foreign investment across the region, the establishment of SAFE and the growing economic and financial ties among Bangladesh, India, Pakistan and Sri Lanka might have increased integration among the markets. Second, being the frontline States against the 'war on terror' the effect of September 11, 2001 terrorist attacks might have increased integration via any 'contagion' which spread from the US. Third, retrenchment by US foreign nationals who invested in Bangladesh, India, Pakistan and Sri Lanka may have seen the impact of 9/11 transmitted to equity markets in the region.

The results should be of interest to academics, foreign investors and domestic shareholders as well as governments who want to understand how these markets have behaved in a recent time period. All should be interested in the pricing efficiency of the stock markets in the region. For instance, investors may wish to discover whether any profitable trading strategies can be identified not only by considering historic information from their country but also from the other three countries in the region. Governments and policy-makers may be more concerned about whether any regulations need to be strengthened and information flows improved in order to aid the price discovery process in Bangladesh, India, Pakistan and Sri Lanka. The current thesis may help them with their objectives.

In addition, this investigation offers foreign investors the opportunity to learn about the level of stock market integration in the region and the extent of diversification benefits which this region can offer. Further, with the launch of SAFE in 2000, the findings of the current thesis may provide insights about any achievements which this regional federation of stock exchanges has achieved throughout the first 10 years of its existence; it may highlight where future work is needed to foster co-operation among the stock markets of Bangladesh, India, Pakistan and Sri Lanka.

The current thesis makes a number of contributions to the literature. First, most of the previous studies which have investigated integration among stock markets have ignored the South Asian region. The current thesis investigates four of the established stock markets in the region for which data were available over the time period being examined. Second, both long- and short-run analyses are carried out using various sophisticated econometric techniques. To date, a great deal of the analysis which has been conducted has employed basic tests of the EMH looking at correlations and trend analysis. Third, the results from the findings of this thesis have implications for market efficiency as well as for international portfolio diversification in the region. Thus, the thesis is able to make a contribution at both a national and international level. This contribution is at the domestic policy level as well as at the global asset allocation level of large investment funds. Fourth, the thesis does not concentrate on financial markets in isolation. An attempt is made to relate any predictability in share returns or linkages across markets to macroeconomic variables which measure each country's performance; findings about each financial market are related to the real economy of its own country as well as the economies of the other three countries being considered. A contribution of the current thesis therefore is that a sizeable number of macroeconomic variables are investigated in this strand of the research. Most previous studies in the area have ignored the effect of international economic variables on share returns. In this thesis, a combination of both local and global variables are investigated to understand whether domestic variables are important or international factors explain share returns in the regional markets. Fifth, relatively little is known about volatility and return spillovers in these regional markets. In addition, most previous studies which have considered this issue have investigated spillovers from the developed markets to emerging stock markets have used either univariate or bivariate GARCH models. The current thesis examines return and volatility spillovers by employing the multivariate GARCH-BEKK model in order to investigate cross-market spillovers of return and volatility across four markets. Finally, from the review of the literature, it is evident that important international events such as the global stock market crash of 1987 and the Asian crisis of 1997-1998 have affected stock market integration. The current thesis investigates the impact of another event on the South Asian region (i.e. the attack on the World Trade Centre in September 2001). The analysis is carried out for the entire 18- year time period as well for two sub-periods to examine whether linkages among the stock markets have increased over time and to analyse the impact of this event on the linkages among the emerging stock markets of the region.

### 1.3: Research Questions and Research Approach

This thesis seeks to answer a number of different research questions. First, it investigates whether share price changes in the four South Asian emerging stock markets of Bangladesh, India, Pakistan and Sri Lanka are independent. The answer to this question has implications for stock market efficiency which suggests that stock returns in an efficient market should not be predictable or related to lagged stock returns in other markets (Chan et al., 1997). In addition, cointegration among equity prices would suggest that the stock markets co-move together in the long-run; the presence of cointegration would therefore suggest that a short-run dynamic relationship exists between equity returns in one market and lagged price changes in its own and other markets contradicting the weak form of the EMH. The answer to this first question also has implications for portfolio diversification. In integrated markets the potential for international portfolio diversification is diminished due to the similarity in equity return behaviour over the long-run. Thus, the results from the first question can have implications in a number of areas.

Second, this thesis examines whether share price changes are related to changes in local and global macroeconomic variables. The presence of inter-relationships between local and or global economic variables and share returns could be interpreted as a linkage between the real and financial sectors within a country; however, it may also provide evidence of stock market inefficiency since it may suggest that current equity returns are predictable from lagged changes in macroeconomic variables[10]. Third, this thesis examines the interactions among the four regional stock markets from the perspective of return and volatility spillovers in both own and cross-markets. To this end, the research seeks to answer the question of whether share price and volatility changes in one market are related to lag variations in equity returns and risk in other markets. Again, evidence of such spillovers might indicate that the weak form of the EMH is violated because of the

[10] According to Laopodis (2011), an increase in economic activities generates positive forecasts for higher earnings and profits of firms which, in turn, might lead to increase dividend pay-outs to shareholders. Thus, the firm’s stock value would be in line with economic fundamentals.

predictability which the spillover represents. Finally, the thesis investigates whether events of international importance, such as the terrorist attack of September 11, 2001 in the USA, have affected linkages in the regional markets. The thesis analyses linkages for the entire period as well as for two sub-periods before and after the September, 2001 attack on the World Trade Centre.

A mix of methods is used to address the research questions tackled in this thesis. First, multivariate cointegration analysis is used to uncover any long-run relationships among the markets. Several techniques are then used to find out whether any short-run relationships may be present; these include the Vector Error Correction Model (VECM) method, Granger-Causality tests, Impulse Response Function analysis and Variance Decomposition analysis to examine whether current share price changes are related to historic information. Principal Components Analysis (PCA) and regression analysis are used to examine the association between share price changes and changes in both local as well as international macroeconomic variables. A separate model is examined (i) for local; and (ii) for local and global factors for each of the four stock markets. The multivariate GARCH-BEKK model is then used to investigate simultaneously the interactions among the return and volatility across the four markets. A separate model is estimated for (i) the entire period; and (ii) the two sub-periods of pre- and post-September, 2001.

### 1.4: Structure of the Thesis

The remainder of the thesis is organised as follows. Chapter 2 supplies background information about the development of the four South Asian stock markets being examined and provide a context for the remainder of the thesis. In particular, this chapter outlines different definitions of the term ‘emerging market’ that have been proposed by various academics and practitioners. The issue of whether the South Asian markets examined in this thesis can be categorised as ‘emerging’ is also discussed. The chapter further discusses the past as well as recent economic performances of the South Asian countries and outlines how the stock exchanges in the region have developed. Finally, the chapter highlights current trends in the stock markets of Bangladesh, India, Pakistan and Sri Lanka which may inform the empirical results that are uncovered in the thesis.

The relevant literature is reviewed in Chapter 3; this review highlights a number of key topics within the ESM literature. The chapter discusses the empirical research that has examined the weak-form of the EMH using various statistical and econometric techniques. Specifically, the chapter begins by summarising various studies in the area from three broad perspectives. First, the discussion covers linkages among emerging stock markets and the impact of inter-relationships on market efficiency as well as on the benefits of diversification. The second part of the literature review discusses the relationships among various macroeconomic variables and share price changes in emerging stock markets. The third part of this Section of Chapter 3 outlines the relevant literature which has examined stock market interactions from the perspective of (i) changes in share prices; and (ii) volatility. Finally, the chapter highlights the gains from international portfolio diversification in general as well as the potential benefits for foreign investors from investing in emerging stock markets. Throughout this literature review, an attempt is made to concentrate on studies that have reported findings for Bangladesh, India, Pakistan and Sri Lanka. Obviously, a great deal of research exists in this area but the author has focussed on investigations that were relevant both to the region being analysed and the methods being employed.

The methodology and methods underpinning the research in the current thesis are outlined in Chapter 4. This chapter describes Burrell and Morgan's (1979) assumptions about social science research. Based on these assumptions, the four paradigms proposed by Burrell and Morgan (interpretive, functionalist, radical humanist and radical structuralist) are discussed. Because of the questions addressed in this thesis, it is argued that the research lies in the functionalist paradigm. The reasons for the selection of the functionalist paradigm are outlined. The research methods employed in this thesis are then discussed and their appropriateness to the functionalist paradigm explained.

Chapter 5 presents the first empirical analysis of the study, which examines the long-run equilibrium relationships and short-run dynamic linkages among the four South Asian emerging markets. In particular, the chapter starts with a description of the data and preliminary data analysis. Unit root tests are conducted to examine the stationarity and / or presence of a unit root in the values for the four stock market indices. Weekly data are used for the markets of Bangladesh, India, Pakistan and Sri Lanka over the 1993 to 2010 time period. The chapter investigates long- and short-run linkages for the whole time span as well as for two sub-periods to examine whether integration among the markets is consistent or has increased over time.

Chapter 6 presents the findings from an analysis of the relationships between macroeconomic variables and share returns in the four markets under investigation. The chapter initially highlights prior evidence of relationships among economic variables and share returns in previous studies. This evidence helped guide the author on the choice of macroeconomic variables to be studied in the current thesis. PCA is used to reduce the dimensionality of the 12 local and global economic variables. Principal components are then constructed based on the eigenvalues and regression analysis is used to evaluate the predictability of share returns from past economic factors. The findings from the regression model for the local only variables- as well as for both local and global factors- are discussed.

Chapter 7 presents the findings about the transmission mechanisms which exist among the stock markets in the South Asian region. To analyse the interactions among the four markets, this chapter investigates returns and volatility spillovers. The purpose of this analysis is to investigate the linkages among the markets in greater depth. The chapter outlines the findings of both the return and volatility spillovers for the entire period as well as for the two sub-periods using the multivariate GARCH-BEKK model of Engle and Kroner (1995). These results are examined for returns and volatility transmission in own as well as across the four markets simultaneously.

Finally, Chapter 8 concludes the thesis. This chapter details the main findings and discusses the contributions of the research to our understanding of market efficiency in the region. The implications of these findings for the research questions posed are highlighted in detail. The chapter concludes with a discussion of the limitations of the study along with suggestions for future research on this topic.

## 1.5: Conclusion

This chapter has introduced the reader to the remainder of this thesis. It has shed some light on the focus and importance of the research. In addition, the chapter has provided a 'road map' to guide the reader on the structure and content of the thesis. In particular, it has highlighted that the research questions studied in this thesis focus on (i) integration among the stock markets of the South Asian region over the long- and short-run; (ii) whether domestic or international economic factors are important in explaining share returns in the regional markets being studied; and (iii) whether own or cross-market return and volatility spillovers are present among the South Asian emerging stock markets of Bangladesh, India, Pakistan and Sri Lanka.

# Chapter 2

# An Overview of the Four South Asian Stock Markets Examined

## 2.1: Introduction

This chapter provides an introduction to the historical development of the South Asian stock markets which should supply a context for the remainder of the thesis. In particular, the chapter presents an overview of the economies and stock exchanges of Bangladesh, India, Pakistan and Sri Lanka. In this region, the stock markets have a varied history with the exchanges in two of the countries (India and Sri Lanka) dating back more than a century; by contrast, the stock markets in Bangladesh and Pakistan are relatively new. However, despite their age differences, all four stock markets are considered as emerging. This brief history of the region's exchanges will help in analysing the performance of the markets and will provide a background for the empirical analysis in subsequent chapters.

The remainder of the current chapter is organised as follows. Section 2.2 outlines the various definitions of 'Emerging Markets' that have been employed by practitioners and academics. Section 2.3 then considers whether the South Asian markets examined in this thesis can be categorised as emerging. Section 2.4 discusses the economic performance of the individual countries included in this study while Section 2.5 comments on the development of the region's stock markets over time. In Section 2.6, the current trends in the stock markets of Bangladesh, India, Pakistan and Sri Lanka are discussed. Finally, Section 2.7 provides a brief conclusion to the chapter.

## 2.2: Defining Emerging Markets

The development of emerging markets as a distinctive investment category is relatively recent (Fifield et al; 1998). For example, in the early 1970's, Robert McNamara, President of the World Bank, established the International Finance Corporation (IFC) in order to promote the establishment of financial markets particularly in developing countries. The major focus of the IFC was to channel resources more efficiently into companies listed on the exchanges of developing countries. Because of this IFC focus, interest in developing countries among institutional investors increased in the late 1980's (Mobius, 1994).

The term 'emerging market' initially appeared in the literature around 1981. The first listed fund in this category was the Templeton Emerging Markets fund which was established in 1987 and was managed by Mark Mobius. Mobius (1994) reported that until 1987, although the term 'emerging market' existed, there was no precise definition that was used to classify markets as emerging. The first development in this regard was the IFC definition which classified countries according to their income status, based on the World Bank's classification of low-, middle- and high-income economies. According to the IFC definition, stock markets in countries with low and middle income *per capita* were considered to be 'emerging' (Mobius, 1994).

The first problem with this definition was that exceptions arose. For example, the high-income oil-producing countries of Kuwait, Saudi Arabia and the United Arab Emirates were excluded from the developing market grouping. These countries had relatively high *per capita* income, but this income was concentrated in the hands of a few individuals.

Hence, the living standards of the general masses were not the same as those in the developed countries of the world such as the UK and the US. Second, the capital markets in these oil-rich countries were not very developed; trading volumes were low, liquidity was poor and security dealing was slow with little or no technology employed in the process (Al-Abdulqader et al. 2007). Third, many of these high-income under-developed countries placed restrictions on the inflow and outflow of capital to and from their stock markets. In addition, their taxation policies sometimes treated foreigners less favourably than domestic investors (Mobius, 1994).

As a result, Mobius (1994) put forward his own definition of an emerging market. In particular, he defined a market to be 'emerging' if it was not located in North America or the EAFE[11]. Furthermore, he argued that the emerging market should have the following characteristics: (i) a well-functioning stock exchange; (ii) a supply of securities available for foreign investors; and (iii) no restrictions on the flow of capital to and from the country[12].

According to Errunza (1983), the term 'emerging markets' subsumes three categories of financial markets. The first category is that of the old established markets, including the Argentina, Brazil, Chile, Greece, India, Mexico, Spain, Portugal and Zimbabwe (formally Rhodesia); exchanges date back more than a century but only played a minor role in raising equity capital for corporate investment[13]. The second category of emerging markets was those established due to special situations. For example, the stock market in

[11] North America includes the US and Canada and EAFE includes Europe, Australia, and the Far East countries.
[12] By these criteria, out of the list of 123 countries considered as developing, only 24 fulfilled the conditions to be considered 'emerging' in 1992 (Mobius, 1994).
[13] An execption to this generalisation relates to India and Zimbabwe in colonial times.

Jordan was established to absorb the OPEC money due to turmoil in the Middle Eastern markets. The third category of emerging markets included the new markets of Korea and the Philippines, which were organised to speed up economic growth in these countries. Although this classification provides no distinct definition of an emerging market, it provides a guide as to the financial markets that the term 'emerging markets' may embrace (Fifield et al., 1998).

Divecha et al. (1992) adopted an alternative definition of an emerging market from the practitioner perspective that was employed by Mobius (1994). They considered an emerging market as one where: (i) there is a market for the trading of securities; (ii) the country in which it is located is not developed according to the Morgan Stanley Capital International Indices (MSCI) list or Financial Times Indices; (iii) the market is accessible for investment by foreign investors; and (iv) the market has a reliable source of data. This definition therefore adopts both an academic and a practitioner's perspective on what constitutes an emerging market; the academic component, which focuses on the stage of development of the country, is tempered by the practical consideration of whether investment is possible.

Another widely used definition of an 'emerging market' was pioneered by the Emerging Markets Database (EMDB)[14] which is now maintained by Standard and Poor's. According to Standard and Poor's definition, an emerging market is one which: (i) is located in a country with low or middle income as defined by the World Bank[15]; (ii) has an investable market capitalisation that is low relative to the country's Gross National

[14] The Emerging Market Database was established by the IFC but was acquired by Standard and Poor's in 2000 (S&P 2009).
[15] According to the World Bank (2009), countries with a Gross National Income (GNI) *per capita* greater than US$11456 are considered to be high income countries.

Income (GNI) level; and (iii) has few restrictions on foreign investment (Standard and Poor's, 2009).

The IFC definition has been widely used to identify emerging markets in the academic literature (see for example, Wilcox, 1992; Hartmann and Khambata, 1993). However, the definition is not universally accepted as practitioners consider many other factors in their decisions about investing in these markets. For example, Middleton et al. (2007) surveyed practitioners about their definition of an emerging market in the Central and Eastern European region. They documented that practitioners viewed the barriers to investment in these markets as a key consideration when deciding where to invest. They also focused on the liquidity of a market and the size of companies available for investment[16].

From this discussion, it is apparent that there is still no universally accepted definition as to what constitutes an emerging market. However, most researchers have used the IFC income-based criterion when identifying countries whose stock markets might be characterised as emerging. In addition, they have tended to restrict their definition to those countries where investment is practically possible for foreign investors.

### 2.3: Can South Asian Markets Be Considered Emerging?

The countries of Bangladesh, India, Pakistan and Sri Lanka are considered in this study; these countries are collectively known as the South Asian region (Gunasekarage and

[16] These results may be more specific for the CEE region because of their transition towards the EU, and because of the limited number of practitioners interviewed in the study.

Power, 2001; Narayan et al., 2004)[17]. The ratio of market capitalisation to GNI is relatively low for these countries; this measure is one of the criteria employed by Standard and Poor's when deciding whether or not a market should be included in its emerging markets list. While GNI and GNI *per capita* highlight whether an economy is in the low, middle or high income category, the market capitalisation to GNI ratio highlights the importance of a stock market within a country. When the income level of a country is in the low or middle categories and its market capitalisation to GNI ratio is low, its stock market tends to be considered as 'emerging' according to Standard and Poor's (2009).

Table 2.1 supplies detailed information about the economic performance of the four countries from the South Asian region. In particular, GNI, GNI *per capita* and market capitalisation to GNI data are provided for the 12-year period 2000 to 2011. An inspection of this table reveals that the performance of these countries has varied throughout the decade. For example, they have grown at different rates; Indian GNI grew from US$458.1bn to US$1030.2bn in 2011, a rise of 124.9 per cent. The GNI of Bangladesh increased from US$49.8bn in 2000 to US$95.3bn in 2011, a rise of 91.3 per cent. By contrast, the GNI for Pakistan and Sri Lanka rose by the smaller amounts of 82.8 and 76.2 per cent to US$123.8bn and US$ 95.3bn, respectively. In comparison, GNI in developed countries has increased at a much lower rate over the same time frame[18].

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[17] Although the region includes other countries, such as Afghanistan, Bhutan, the Maldives and Nepal, these countries either have no active stock exchange, newly established stock markets or their effect in terms of number of listed companies, on the region is negligible.

[18] In fact, according to the World Bank, GNI for the UK grew by 16.5 per cent over the 2000 – 2011 period (World Bank, 2012).

Although GNI for these South Asian countries increased year by year, their populations remained relatively poor. A detailed inspection of Table 2.1 reveals that average GNI *per capita* values for the four South Asian countries were US$1440, US$805, US$767 and US$482 for Sri Lanka, India, Pakistan and Bangladesh, respectively. During the same time period, the average value of GNI *per capita* for the UK was US$32117. Though the values of GNI *per capita* grew for all four countries in this study, they increased at different rates; the highest growth of 213 per cent was achieved by India. India's impressive performance was closely followed by Sri Lanka, Pakistan and Bangladesh with growth rates of 193 per cent, 128 per cent and 120 per cent, respectively. However, despite this growth in GNI *per capita*, these countries were still in the low and middle income categories specified by the World Bank; according to the 2011 income figures, India, Pakistan and Sri Lanka were in the lower- middle income category of the World Bank's definition while Bangladesh was in the low-income category. Thus, there is *prima facie* evidence for categorising the stock markets in these countries as emerging since they satisfy the IFC's definition based on the World Bank criteria.

Perhaps the greatest difference among the four countries relates to their Market Capitalisation to GNI ratios. The importance of the stock market was greatest for India which had the highest Market Capitalisation/GNI ratio over the period considered. Pakistan was ranked second, Sri Lanka third and Bangladesh fourth. In addition, these ratios increased dramatically between 2000 and 2011 which is particularly impressive given that the GNI values grew throughout the whole of the decade; that is, the market capitalisation of listed companies increased at a faster rate. Growth in the ratio of Market Capitalisation to GNI was impressive for the four countries with Sri Lanka leading the region with a growth rate of 932 per cent followed by Bangladesh, India and Pakistan with growth rates of 925 per cent, 143 per cent and 99.7 per cent, respectively. However, by 2011, none of the Market Capitalisation to GNI ratios was at the level typically documented for developed countries. For example, the highest ratio for India in 2006 (0.867) was only two thirds of the equivalent ratio for the UK (1.305).

The final point to emerge from Table 2.1 is that the Market Capitalisation to GNI ratios exhibited a level of volatility which is typically not associated with a stock market in a developed country. For example, the ratio for India fell dramatically from 0.867 in 2006 to 0.163 in 2007. The year 2008 seems to have been associated with a stock market collapse in Pakistan and Sri Lanka as their Market Capitalisation to GNI ratios declined by 70.2 and 50.6 per cent, respectively. As a result of these declines, the gap between the highest and lowest ratio for these four countries fell during 2007 and 2008 but has widened again in 2009 and 2010 as the Indian stock market recovered.

One conclusion from this discussion is that the stock markets in the South Asian region satisfy the definition of an emerging market. These markets are in the low and middle GNI categories and their Market Capitalisation to GNI ratios are still relatively low. Although the markets are open to foreign investors, they appear to be volatile.

**Table 2.1: Economic Statistics and Market Capitalisation Values for the Sample Countries, 2000-2011**

| Country | Indicator | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bangladesh** | GNI (bn) | 49.8 | 50.6 | 51.1 | 55 | 61.3 | 66.8 | 70.5 | 74.9 | 83.4 | 95.4 | 90.2 | 95.3 |
| | Growth % | NA | 1.6 | 0.98 | 7.63 | 11.45 | 8.97 | 5.54 | 6.24 | 11.34 | 14.39 | -5.45 | 5.65 |
| | GNI *per capita* | 350 | 350 | 350 | 370 | 410 | 440 | 450 | 480 | 520 | 590 | 700 | 770 |
| | Market Cap/GNI | 0.024 | 0.023 | 0.023 | 0.029 | 0.054 | 0.045 | 0.051 | 0.091 | 0.080 | 0.074 | 0.174 | 0.246 |
| **India** | GNI (bn) | 458 | 478.5 | 492.6 | 567.6 | 687 | 823 | 944.1 | 1117 | 1235 | 1367 | 963.3 | 1030.2 |
| | Growth % | NA | 4.47 | 2.94 | 15.2 | 21 | 19.8 | 14.7 | 18.3 | 10.56 | 10.68 | -2.95 | 6.94 |
| | GNI *per capita* | 450 | 460 | 470 | 530 | 640 | 750 | 850 | 990 | 1080 | 1180 | 1260 | 1410 |
| | Market Cap/GNI | 0.323 | 0.231 | 0.259 | 0.492 | 0.565 | 0.672 | 0.867 | 0.163 | 0.523 | 0.863 | 0.676 | 0.785 |
| **Pakistan** | GNI (bn) | 67.7 | 70 | 74.4 | 83 | 97 | 113 | 126 | 140 | 157.5 | 127.9 | 120.2 | 123.8 |
| | Growth % | NA | 3.4 | 6.28 | 11.56 | 16.86 | 16.5 | 11.5 | 11.11 | 12.5 | -18.29 | -6.02 | 2.99 |
| | GNI *per capita* | 490 | 500 | 510 | 560 | 640 | 720 | 790 | 860 | 950 | 1020 | 1050 | 1120 |
| | Market Cap/GNI | 0.097 | 0.071 | 0.137 | 0.199 | 0.299 | 0.407 | 0.360 | 0.501 | 0.149 | 0.192 | 0.317 | 0.265 |
| **Sri Lanka** | GNI (bn) | 16.4 | 15.7 | 16.3 | 18 | 21 | 23.7 | 26.8 | 30.8 | 35.8 | 40.4 | 26.6 | 28.9 |
| | Growth % | NA | -4.27 | 3.8 | 10.4 | 16.67 | 12.85 | 13.08 | 14.9 | 16.2 | 12.8 | -34.15 | 8.64 |
| | GNI *per capita* | 880 | 830 | 860 | 950 | 1070 | 1200 | 1350 | 1540 | 1780 | 1990 | 2260 | 2580 |
| | Market Cap/GNI | 0.065 | 0.085 | 0.103 | 0.148 | 0.175 | 0.241 | 0.290 | 0.245 | 0.121 | 0.201 | 0.748 | 0.671 |
| **UK** | GNI (bn) | 1526 | 1529 | 1556 | 1733 | 2075 | 2344 | 2495 | 2691 | 2834 | 2567 | 1752 | 1778 |
| | Growth % | NA | 0.19 | 1.76 | 11.37 | 19.7 | 12.96 | 6.44 | 7.8 | 5.31 | -9.42 | -31.74 | 1.48 |
| | GNI *per capita* | 25910 | 25860 | 26230 | 29080 | 34650 | 38920 | 41160 | 44140 | 46150 | 41520 | 38140 | 37780 |
| | Market Cap/GNI | 1.689 | 1.416 | 1.198 | 1.420 | 1.357 | 1.305 | 1.521 | 1.434 | 0.653 | 1.089 | 1.773 | 0.676 |

Source: The World Bank (2012). The table details economic statistics and market capitalisation values for the four South Asian countries of Bangladesh, India, Pakistan and Sri Lanka, and the UK, over the twelve-year period 2000-2011. GNI is Gross National Income, while Growth shows the year-on-year growth in GNI, Market Cap is the capitalisation of listed companies in US dollars, GNI and GNI *per capita* are calculated by the Atlas method and are in US dollars. Market Cap/GNI is the ratio of market capitalisation to gross national income. NA indicates that data are not available for that particular year.

### 2.4: The Economic Performance of the South Asian Countries

According to a broader range of indicators than the variables considered in Table 2.1, the sample countries in the South Asian region performed well especially during the recent period 2005 to 2009. Major economic indicators like Gross Domestic Product (GDP), inflation, the current account balance and the capital account balance were generally favourable for the region. Table 2.2 summarises key economic indicators for the South Asian countries. The table indicates that there was a general upward shift in the nominal GDP of all four emerging countries of the South Asian region. For example, during the most recent five-year period from 2007 to 2011, GDP for Bangladesh increased from US$68.4bn to US$110.6bn: In India, GDP grew by an even faster rate and reached US$1848bn in 2011. The lowest GDP was recorded for Sri Lanka while the highest GDP value was achieved by India.

It is not surprising that the growth in GDP for these countries was associated with evidence of price rises. For example, inflation values, as measured by the GDP deflator, were relatively high for all countries in the sample - especially Pakistan and Sri Lanka, which recorded inflation levels of 19.9 per cent in 2009 and 16.3 per cent in 2008, respectively. For India and Bangladesh, the inflation rate remained in single digits for the whole time period[19].

[19] Table 2.1 suggests that the countries in the region responded differently to the global financial crisis during these years, possibly because the exports of goods and services varied across the countries being studied.

**Table 2.2: Key Economic Indicators of the South Asian Countries, 2007- 2011**

| Country | Year | GDP (US$bn) | Inflation % | Net Capital Account ( US$bn) | Current Account Balance( US$bn) | Current Account Balance(% of GDP) | Total Reserves (US$bn) | Imports (% of GDP) | Exports (% of GDP) |
|---|---|---|---|---|---|---|---|---|---|
| Bangladesh | **2007** | 68.4 | 6.8 | 71.5 | 85.7 | 1.3 | 5.3 | 27 | 20 |
| | **2008** | 79.6 | 8.8 | 49.0 | 92.6 | 1.2 | 5.8 | 29 | 20 |
| | **2009** | 89.4 | 6.5 | 47.4 | 355.6 | 3.9 | 10.3 | 27 | 19 |
| | **2010** | 100.4 | 6.5 | 60.3 | 210.8 | 2.0 | 11.2 | 25 | 18 |
| | **2011** | 110.6 | 6.3 | 52.7 | 24.3 | 0.2 | 9.2 | 31 | 23 |
| India | **2007** | 1238 | 5.8 | NA | -807.6 | -2.5 | 276.6 | 24 | 20 |
| | **2008** | 1224 | 7.8 | NA | -3097.1 | -1.9 | 257.4 | 29 | 24 |
| | **2009** | 1361 | 6.0 | NA | -2592.1 | -3.0 | 284.7 | 26 | 20 |
| | **2010** | 1684 | 8.5 | NA | -5178.0 | -3.0 | 300.5 | 27 | 23 |
| | **2011** | 1848 | 8.0 | NA | NA | NA | 298.7 | 30 | 25 |
| Pakistan | **2007** | 143.0 | 7.7 | 17.3 | -830.1 | -5.8 | 15.8 | 21 | 14 |
| | **2008** | 163.0 | 16.2 | 14.8 | -1565.4 | -9.6 | 9.0 | 24 | 13 |
| | **2009** | 162.6 | 19.9 | 48.4 | -399.3 | -2.4 | 13.6 | 20 | 13 |
| | **2010** | 176.5 | 12.0 | 10.9 | -135.4 | -0.8 | 17.3 | 19 | 14 |
| | **2011** | 211.2 | 11.9 | 22.1 | -223.4 | -1.1 | 17.7 | 16 | 12 |
| Sri Lanka | **2007** | 32.4 | 14.0 | 26.8 | -140.0 | -4.2 | 3.5 | 39 | 29 |
| | **2008** | 40.7 | 16.3 | 29.0 | -388.5 | -9.5 | 2.6 | 39 | 25 |
| | **2009** | 42.0 | 5.9 | 23.3 | -21.4 | -0.5 | 5.4 | 28 | 21 |
| | **2010** | 49.6 | 7.3 | 16.3 | -107.5 | -2.2 | 7.2 | 31 | 22 |
| | **2011** | 59.1 | 7.8 | 14.4 | -461.5 | -7.8 | 6.7 | 36 | 24 |
| UK | **2007** | 2812 | 2.3 | 515.9 | -7107.9 | -5.0 | 57.2 | 30 | 27 |
| | **2008** | 2636 | 3.1 | 597.5 | -4115.9 | -2.9 | 53.0 | 32 | 29 |
| | **2009** | 2171 | 1.7 | 570.9 | -3705.0 | -0.3 | 66.6 | 30 | 28 |
| | **2010** | 2252 | 2.9 | 581.5 | -7522.8 | -5.2 | 82.4 | 33 | 30 |
| | **2011** | 2432 | 2.3 | 618.6 | -4646.4 | -3.1 | 94.5 | 34 | 32 |

Source: World Bank (2012). The table shows key economic indicators for the four South Asian countries of Bangladesh, India, Pakistan and Sri Lanka and the UK, over the five-year period 2007-2011. In particular, the table shows GDP which is measured at constant prices, inflation, the net capital account, the current account balance, and the current account balance as a percentage of GDP, total reserves and imports and exports as a percentage of GDP. NA indicates that data are not available.

Table 2.2 also shows the net capital account balance[20] for the countries where data were available. The balance on the capital account remained positive for all countries during the period 2007 to 2011; thus, the net flow of funds was positive in the countries, indicating that foreign investment in domestic assets remained greater than domestic investment in foreign assets. It reveals that capital inflows from abroad were higher than capital outflows from the sample countries. For three of the countries (Bangladesh, Pakistan and Sri Lanka), the capital account balance was lower than those of many developed economies. For example, the highest value for the capital account balance in these three emerging countries was US$60.3bn for Bangladesh in 2010 as compared to US$618.6bn for the UK in 2011. In contrast to the capital account, the current account balance[21] was in deficit for all the countries in the sample, although it was in surplus for Bangladesh only during the period. The current account balance as a percentage of GDP was relatively high in Pakistan and Sri Lanka and relatively low in Bangladesh.

Foreign reserves including gold grew during the period studied. In the four countries of Bangladesh, India, Pakistan, and Sri Lanka, the value of reserves increased from a total of US$5.3bn, US$276.6bn, US$15.8bn and US$3.5bn in 2007 to a total of US$9.2bn, US$298.7bn, US$17.7bn, and US$6.7bn, respectively in 2011. Over the same period, reserves in the UK reached a level of US$94.5bn in 2011 from a low value of US$57.2bn in 2007.

[20] According to the World Bank (2012), the net capital account includes government debt forgiveness, investment grants in cash or in kind by a government entity and taxes on capital transfers. It also includes migrant capital transfers and investment grants by nongovernment entities.

[21] The current account balance represents the sum of net exports of goods, services, net income and net current transfers (World Bank, 2012).

Table 2.2 also shows values for imports and exports of goods and services as a percentage of GDP. In Bangladesh, imports increased by 4 per cent whereas exports grew by 3 per cent. In India, a similar picture emerges; the growth rate for imports was one per cent higher than that for exports. In Pakistan, exports fell by 2 per cent which may have been due to the global recession in recent years (Bhaskaran, 2009). In Sri Lanka, both imports and exports decreased by 3 per cent and 5 per cent respectively; this poor performance might be explained by the political turmoil which existed in Sri Lanka over the time period[22].

In recent years, foreign investors have shown an increased interest in the South Asian region. Both foreign direct investment (FDI) and portfolio investment in equities has increased by varying amounts, for the sample countries[23]. According to Table 2.3, portfolio equity investment flows, FDI and FDI as a percentage of GDP varied for the four South Asian economies over the years 2000 to 2010. One reason for this variation may have been the volatile nature of portfolio investment in some of the emerging markets concerned: the level of uncertainty has been high due to local political and economic conditions (Aggarwal et al., 1999). In addition, stock market declines in a foreign investor's home country may have caused portfolio managers to repatriate equity capital from foreign investments which may have led to turbulence in the ESMs; such an argument may explain the portfolio investment reductions in Bangladesh, India and

[22] For example, during the years 1983 to 2009 a civil war raged in Sri Lanka which disrupted a lot of economic activity in the country and deviated a great deal of Government resources into military spending. In addition, the country was further damaged by the 2004 tsunami (Asia Economic Institute, 2012).

[23] FDI are the net inflows of investment to acquire a lasting management interest (10 per cent or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments. In addition, portfolio equity includes net inflows from equity securities other than those recorded as direct investment and including shares, stocks, depository receipts (American or global), and direct purchases of shares in local stock markets by foreign investors (World Bank, 2012).

Pakistan during 2008 (see Table 2.3). In spite of this turbulence, India continued to attract the largest inflow of foreign investment while Sri Lanka witnessed the smallest amount.

## Table 2.3: Foreign Investment in the Sample Countries

| Country | Indicator | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bangladesh | FPI ($ bn) | 0.119 | -0.348 | -0.137 | 0.163 | 0.426 | 1.952 | 3.079 | 15.338 | -4.827 | -15.402 | -0.0006 |
| | FDI ($ bn) | 28.038 | 7.853 | 4.966 | 26.551 | 44.484 | 81.138 | 69.721 | 65.482 | 100.962 | 67.425 | 91.690 |
| | FDI (% of GDP) | 0.600 | 0.200 | 0.100 | 0.500 | 0.800 | 1.300 | 1.100 | 1.000 | 1.300 | 0.800 | 0.900 |
| India | FPI ( $ bn) | 248.131 | 294.958 | 106.339 | 821.619 | 905.398 | 1215.121 | 950.911 | 3498.588 | -1502.977 | 2111.100 | 3997.2 |
| | FDI ($ bn) | 307.468 | 407.396 | 394.790 | 244.414 | 359.219 | 462.865 | 599.229 | 784.687 | 2280.703 | 3559.586 | 2415.918 |
| | FDI (% of GDP) | 0.800 | 1.100 | 1.100 | 0.700 | 0.800 | 0.900 | 2.100 | 2.000 | 3.400 | 2.600 | 1.400 |
| Pakistan | FPI ( $ bn) | 3.500 | -13.000 | 7.900 | -2.600 | 4.900 | 45.100 | 115.200 | 127.600 | -27.000 | -3.700 | 52.400 |
| | FDI ($ bn) | 29.700 | 35.200 | 79.500 | 51.500 | 106.200 | 215.700 | 416.400 | 549.200 | 539.000 | 233.800 | 201.800 |
| | FDI (% of GDP) | 0.400 | 0.500 | 1.100 | 0.600 | 1.100 | 2.000 | 3.400 | 3.900 | 3.300 | 1.400 | 1.100 |
| Sri Lanka | FPI ( $ bn) | NA | -3.469 | -5.263 | -14.320 | -10.035 | -21.550 | -30.400 | -32.201 | -48.790 | -38.150 | -104.860 |
| | FDI ($ bn) | 17.294 | 17.179 | 18.505 | 20.141 | 22.701 | 23.400 | 450.400 | 54.800 | 69.050 | 38.400 | 47.821 |
| | FDI (% of GDP) | 1.100 | 1.100 | 1.100 | 1.200 | 1.100 | 1.100 | 1.700 | 1.900 | 1.800 | 1.000 | 1.000 |

The table details foreign investment in the four South Asian countries of Bangladesh, India, Pakistan and Sri Lanka over the eleven-year period 2000-2010. In particular, the table shows foreign portfolio investment (FPI), Foreign Direct Investment (FDI) and FDI as a percentage of GDP. Negative values indicate a net outflow while positive values show a net inflow to the economy. NA indicates those instances where data were not available.

## Table: 2.4. Total Imports and Exports Among the South Asian Countries

| Country | | | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bangladesh | Imports | India | 1082.7 | 1336.3 | 1040.7 | 504.1 | 881.5 | 1044.2 | 1199.5 | 1581.6 | 1372.0 | 1875.7 | 2333.9 | ---- | ---- | ---- |
| | | Pakistan | 113.5 | 65.4 | 78.9 | 106.3 | 105.0 | 108.1 | 93.4 | 111.4 | 156.7 | 156.0 | 189.1 | ---- | ---- | ---- |
| | Exports | India | 32.1 | 23.9 | 10.4 | 17.7 | 24.6 | 21.4 | 32.1 | 54.0 | 177.7 | 257.9 | 523.7 | ---- | ---- | ---- |
| | | Pakistan | 37.2 | 34.6 | 33.3 | 46.9 | 32.6 | 27.1 | 32.2 | 43.3 | 80.8 | 53.4 | 96.9 | ---- | ---- | ---- |
| India | Imports | Bangladesh | 32.1 | 23.9 | 10.4 | 17.7 | 24.6 | 21.4 | 32.1 | 54.0 | 177.7 | 257.9 | 523.7 | NA | NA | NA |
| | | Pakistan | 33.3 | 204.3 | 81.5 | 65.0 | 54.5 | 48.9 | 95.9 | 158.5 | 337.2 | 326.7 | 291.7 | 354.6 | 235.3 | 275.0 |
| | | Sri Lanka | 44.0 | 44.0 | 47.0 | 58.0 | 72.0 | 170.3 | 241.1 | 385.8 | 558.8 | 489.0 | 515.8 | 444.0 | 325.0 | 468.2 |
| | Exports | Bangladesh | 786.7 | 995.3 | 635.7 | 949.5 | 1013.2 | 1170.5 | 1719.4 | 1593.5 | 1719.8 | 1667.8 | 2063.8 | 3243.4 | 2177.4 | 3016.6 |
| | | Pakistan | 142.2 | 153.6 | 130.7 | 183.2 | 240.8 | 162.5 | 381.1 | 454.4 | 576.7 | 1115.0 | 1266.2 | 1691.5 | 1080.4 | 1559.9 |
| | | Sri Lanka | 562.0 | 562.0 | 509.5 | 600.1 | 602.4 | 834.0 | 1076.4 | 1360.1 | 1439.3 | 1805.1 | 2781.4 | 2836.2 | 1694.0 | 2549.4 |
| Pakistan | Imports | Bangladesh | 37.2 | 34.6 | 33.3 | 46.9 | 32.6 | 27.1 | 32.2 | 43.3 | 80.8 | 53.4 | 96.9 | NA | NA | NA |
| | | India | 142.2 | 153.6 | 130.7 | 183.2 | 240.8 | 162.5 | 381.1 | 454.4 | 576.7 | 1115.0 | 1266.2 | 1691.5 | 1080.4 | 1559.9 |
| | | Sri Lanka | 38.0 | 38.0 | 30.5 | 29.7 | 24.9 | 28.8 | 36.1 | 39.3 | 43.0 | 58.3 | 55.4 | 72.2 | 55.5 | 60.5 |
| | Exports | Bangladesh | 91.7 | 10.8.6 | 124.9 | 141.6 | 118.7 | 103.9 | 194.4 | 197.7 | 234.4 | 266.8 | 279.3 | 422.3 | 367.4 | 636.8 |
| | | India | 33.3 | 204.3 | 81.5 | 65.0 | 54.5 | 48.8 | 95.9 | 158.5 | 337.2 | 326.7 | 291.7 | 354.6 | 235.3 | 275.0 |
| | | Sri Lanka | 96.6 | 95.3 | 103.2 | 82.0 | 74.6 | 71.4 | 97.6 | 134.7 | 153.7 | 177.6 | 208.6 | 216.7 | 217.0 | 283.9 |
| Sri Lanka | Imports | India | 562.0 | 562.0 | 509.5 | 600.1 | 602.4 | 834.0 | 1076.4 | 1360.1 | 1439.3 | 1805.1 | 2781.4 | 2836.2 | 1694.0 | 2549.4 |
| | | Pakistan | 69.0 | 69.0 | 94.3 | 72.2 | 73.9 | 65.8 | 71.0 | 108.1 | 115.6 | 146.6 | 179.2 | 191.8 | 196.2 | 282.1 |
| | Exports | India | 44.0 | 45.3 | 47.0 | 58.0 | 72.0 | 170.3 | 241.1 | 385.8 | 558.8 | 489.0 | 515.8 | 444.0 | 325.0 | 468.2 |
| | | Pakistan | 38.0 | 38.0 | 30.5 | 29.7 | 24.9 | 28.8 | 36.1 | 39.3 | 43.0 | 58.3 | 55.4 | 72.2 | 55.5 | 60.5 |

Source: International Trade Statistics Yearbook (various issues). The table indicates imports and exports among the four countries of Bangladesh, India, Pakistan and Sri Lanka over the period from 1997 to 2010. All values are in US$m.

However, as a percentage of GDP, the Pakistani economy performed well - especially in the years 2006 to 2008 - presumably because it was boosted by US military investment during the recent war in Afghanistan. Overall, Table 2.3 indicates that FDI in the four South Asian countries increased during the period 2000 to 2010. In Bangladesh, it rose from US$28.0bn to US$91.7bn, in India it increased from US$307.5bn to US$2415.9bn. In Pakistan and Sri Lanka, FDI reached US$201.8bn and US$47.8bn, respectively, over the period studied.

Table 2.4 provides detailed information about international trade between the four South Asian countries considered in this thesis. In particular, import and export data are provided over the most recent 14-year period 1997-2010 subject to the availability of the information[24]. An inspection of the table reveals that, in general, trade amongst the countries has grown over the period. For example, both imports and exports increased, although at different rates and with different countries. Over the 10-year period for Bangladesh, the value of imports increased by 115.7 and 66.6 per cent from India and Pakistan, respectively. Exports from Bangladesh to the two countries grew at a much faster rate - by 1531.5 and 160.5 per cent, respectively - although they started from a much lower base. Imports into India from Bangladesh, Pakistan and Sri Lanka grew by 1531.5, 725.8 and 964.0 per cent, respectively. Such a finding is hardly surprising given the transformation in the Indian economy over the past 15 years (Cagliarini and Baker, 2010). Growth in export values from India to Bangladesh, Pakistan and Sri Lanka were equally impressive at 283.4, 996.7 and 353.6 per cent, respectively. The most dramatic

[24] Data for Bangladesh were available up to 2007 in the most recent available International Trade Statistics Yearbook, 2010. During the period, no data were available for imports and exports between Bangladesh and Sri Lanka in the International Trade Statistics Yearbook.

change in imports into Pakistan relates to the growth in trade with India; imports increased by 966.7 per cent, while exports grew by 725.8 per cent between 1997 and 2010. This change is probably linked to the easing of political as well as military tensions between the two countries. The import and export values for Sri Lanka show a similar picture with import values from India and Pakistan increasing by 353.6 and 308.6 per cent, whereas the export values rose by 964.1 and 59.2 per cent to India and Pakistan, respectively. From the table, it is evident that there has been considerable growth in bilateral trade across these South Asian countries. This growth in trade possibly results from trade liberalisation policies among the countries during the recent period. In addition, various trade agreements, such as for example, the South Asian Preferential Trading Agreement (SAPTA), were introduced to enhance regional trade in the area[25]. From the increased trade among the South Asian countries, there are *ex-ante* expectations of greater integration among the countries' economic fundamentals during recent years.

### 2.5: Liberalisation in the South Asian Stock Markets

Throughout the late 1980's and early 1990's, most developing economies liberalised access to their stock markets in order to attract foreign investment and to allow domestic investors to diversify their portfolios internationally (Bekaert et al., 2003). Numerous benefits have been documented by various researchers for this strategy of financial deregulation among developing economies. Henry (2000a, 2000b), Kim and Singal (2000), Bekaert et al. (2003), Hussain and Qayyum (2005) and Jayasuriya (2005) all

[25] SAPTA was introduced and signed by the SAARC member countries (Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka) in 1993, and came into force in December 1995. It graduated into the South Asia Free Trade Area (SAFTA) in 2004 (Hossain, 2009).

examined the impact of liberalisation on various developing economies throughout the world. For example, Henry (2000a, b) investigated the impact of liberalisation on the cost of capital and the flow of private investment into different countries. Using monthly data for a sample of 12 emerging markets[26] in Latin America and Asia, he examined whether stock market liberalisation had allowed foreign and local investors to share risk and, thus, lower a country's cost of capital[27]. Henry (2000b) reported that nine of the countries which liberalised their financial markets showed a growth in investments for the first year of the change; this number increased to 10 in the second year of the post-liberalisation period. The results of Henry (2000a, b) are supported by the findings of Kim and Singal (2000) who documented that the liberalisation of a country's stock market not only attracted foreign investors but also resulted in the development of the capital market and real economic growth. They further reported that foreign investors demanded more accountability and greater disclosure in the developing countries where they invested which resulted in an increased amount of transparency among the firms in these countries.

One of the perceived negative consequences associated with stock market liberalisation is increased volatility in equity prices. More transactions - especially by foreign investors - may cause destabilising effects in the market and result in higher volatility (Sing, 1997; Kassimatis, 2002; Jayasuriya, 2005). For example, Jayasuriya (2005) investigated the volatility of stock markets after a period of liberalisation. Specifically, he examined the

[26] The Latin American countries included in the sample were Argentina, Brazil, Chile, Colombia, Mexico and Venezuela, while the Asian countries included India, Korea, Malaysia, the Philippines, Taiwan and Thailand.

[27] The reasons why the cost of capital will reduce are because (i) liberalisation may lead to increased inflows of capital which will reduce the risk-free rate; (ii) risk is shared by local and foreign investors; and (iii) the equity premium will be reduced due to greater liquidity (Henry, 2000a, b).

relationship between volatility and market characteristics for 18 emerging markets. The results showed that for seven countries, volatility increased while, for three countries, volatility decreased in the post-liberalisation period. In the rest of the countries, there was no significant change in the volatility after liberalisation[28] had taken place. The markets with less volatility after liberalisation were characterised as having high quality accounting standards, strong investor protection laws and less restrictions on the repatriation of capital in general (La Porta et al., 1998). In addition, most of the countries had well established institutions with no evidence of widespread corruption.

**Table 2.5: Official Dates and Details of Stock Market Liberalisation in South Asian Stock Markets**

| Country | Official Liberalisation Date | Regulatory Changes |
|---|---|---|
| **Bangladesh** | May 1991 | Purchases of Bangladeshi shares and securities by nonresidents, including nonresident Bangladeshis, were allowed subject to meeting specific requirements. |
| **India** | November 1992 | The Government announced that foreign portfolio investors will be able to invest directly in listed Indian companies. |
| **Pakistan** | February 1992 | Relaxation of restrictions on foreigners and nonresident Pakistanis.<br>Purchasing shares of a listed company or subscribing to a public offering of shares subject to some approval being obtained. |
| **Sri Lanka** | January 1991 | Companies incorporated abroad were permitted to invest in securities traded on the Colombo Stock Exchange, subject to the same terms and conditions as those applicable to such investments by approved national funds, approved regional funds, and nonresident individuals. |

Source Bekaert et al. (2003), p. 278-279.

[28] Volatility decreased after liberalisation in Argentina, Brazil, India, Korea, Malaysia, Mexico and Nigeria, while volatility increased in Colombia, Pakistan and Venezuela. No change in volatility was reported for Chile, Greece, Jordan, the Philippines, Taiwan, Thailand, Turkey and Zimbabwe.

Markets in the South Asian region commenced a period of liberalisation in the early 1990's. Table 2.5 shows official dates for regulatory changes in the four South Asian emerging markets analysed in the current research. The dates are taken from Bekaert et al. (2003) and are widely used by many researchers (Henry, 2000 a, b; Kim and Singal, 2000). According to Table 2.5, the stock markets for the sample countries officially relaxed their restrictions on investment by foreigners and non-residents over the years 1991-1992. Surprisingly, this process started with the two smallest countries (Sri Lanka and Bangladesh) where domestic markets for savings were insufficient to fund a growing demand for investment by local listed firms. Pakistan followed in February 1992, while India was the last to permit foreign investors to invest directly in listed companies. Although this practice of liberalisation started at around the same time for the sample countries, the process varied slightly from one country to another. For example, Bangladesh initially focused on non-residents while Sri Lanka only allowed investments by companies incorporated abroad. All countries retained the requirement that foreign investors obtain approval - presumably to monitor the initial changes in ownership that occurred.

**Table 2.6: Foreign Investment Ceiling for Listed Stocks in South Asian Emerging Stock Markets, 2008**

| Country | Regulations |
|---|---|
| **Bangladesh** | 100 per cent in general; some restrictions on defence, nuclear energy, security printing, railways, air transportation and forest plantation. |
| **India** | 24 per cent in general; 20 per cent for banks, 10 per cent for a single FII (Foreign Institutional Investor) in a company.<br>Some sector limits may be higher: individual company limits can be raised to sectoral capitalisation subject to board and Reserve Bank of India (RBI) approval. |
| **Pakistan** | 100 per cent in general. |
| **Sri Lanka** | 100 per cent in general; 40 per cent shipping agency services, timber-based industries, mining, education, travel agencies, mass communications.<br>Some sector limits may be higher but they need approval by the Board of Investment of Sri Lanka (BOI)[29]. |

Source: Standard and Poor's 2009.

Table 2.6 outlines the most recent regulations which the sample countries have adopted for foreign investment. According to Standard and Poor's (2009), two of the region's stock markets (Bangladesh and Pakistan), are considered free for foreign investors, while India and Sri Lanka still have some restrictions in place; shares in all sectors of the economy are not available for acquisition by foreign investors. As Table 2.6 shows, there are still some restrictions for foreign investors in a number of the sample countries, especially Bangladesh and Sri Lanka, where only a minority ownership stake is permitted if the company is in an important industry, such as transportation and timber. For India, there is a limit on the ownership stake which a single foreign investor is allowed to

[29] The Board of Investment of Sri Lanka (BOI) was established as the Greater Colombo Economic Commission in 1978 to promote economic development. It was reconstituted as the Board of Investment of Sri Lanka (BOI) in 1992. It was then structured to function as a central facilitation point for investors. (www.boi.lk).

acquire. By contrast, Pakistan currently places no such restrictions on foreign equity ownership.

According to Standard and Poor's (2009), the markets in the region have almost free entry and exit for foreign investors, although India imposes some restrictions on the repatriation of income and capital. Pakistan and Bangladesh allow investors to enter and leave the market freely. Withholding taxes on dividend income are 15, 10 and 10 per cent in Bangladesh, Pakistan and Sri Lanka, respectively, while there is no tax on dividend income in India. Similarly, there is no tax on long-term capital gains in Bangladesh, Pakistan and Sri Lanka, while India has a 20 per cent tax on capital gains[30].

Hussain and Qayyum (2006) reported that stock market liberalisation in the South Asian region resulted in a significant growth in market capitalisation and trading volumes for the countries concerned. For example, they discovered that in Pakistan, market capitalisation and trading value increased by 157 per cent and 168 per cent, respectively, in the first year of liberalisation. For the Sri Lankan market, the increase was 115 per cent and 457 per cent, respectively. However, the authors argued that market liberalisation was not a major issue for these countries; it resulted in the development of the stock markets in the region but these markets still played a relatively minor role in the development of the real economy at that time. In fact, most firms in Bangladesh, India, Pakistan and Sri Lanka were unquoted and relied on bank debt or government grants for funding.

[30] The tax rates are valid for the year ended December 2008. In 2010, Pakistan introduced a 7.5 per cent tax on 6 month holdings, and a 10 per cent tax on one year holdings (Sharif, 2012).

From this discussion it is apparent that South Asian countries relaxed the regulations concerning foreign investors during the 1990s; presumably this liberalisation followed pressure from developed countries and international financial institutions such as the International Monetary Fund (IMF), (Singh and Weisse, 1998); in many instances, aid was predicated on the introduction of reforms to financial markets ( Abiad and Mody, 2005). This liberalisation resulted in significant capital market developments and has led to further regulatory changes in the region as countries have sought to improve their attractiveness to foreign investors[31]. The establishment of SAFE in 2000 is a recent example of a development which has sought to harmonise the operations of the region's stock exchanges and to make the region attractive for foreign investors[32].

### 2.6: South Asian Stock Exchanges

The stock markets in South Asia vary both in terms of their size as well as their age. Narayan et al. (2004) reported that the Mumbai stock exchange (now known as the Bombay Stock Exchange (BSE)) in India is the sixth largest emerging markets exchange in the world after South Korea, Taiwan, Mexico, Thailand and Malaysia. Indeed, it is the second oldest exchange in Asia after Australia. In fact, the stock exchanges in India and Sri Lanka date back more than a century; the BSE was established in 1875 while the Colombo Stock Exchange (CSE)[33,34] commenced operations in 1896 when the Indian

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[31] Hussain and Qayum (2006) argued that liberalisation of the South Asian stock markets resulted into significant stock market development in terms of increase in market capitalisation and trading values in these markets.

[32] SAFE is a forum of 34 member entities from the SAARC member countries as well as Kazakhstan, Mauritius and UAE. The main objective of the federation is to provide a platform to share exchange and promote the technologies, experiences for the rapid growth and development of capital market and work towards the regional as well as global integration.

[33] At the time of establishment in 1986, the Colombo Stock exchange was known as the Colombo Shares Broker's Association. It was renamed as the Colombo Brokers' Association in 1904, (Asian stock market fact book, 1994-1995).

sub-continent was under British rule. The other two exchanges are relatively newer; the Karachi Stock Exchange (KSE) was established in 1947 after Pakistan gained independence while the Dhaka Stock Exchange (DSE) was formed in 1954 as the East Pakistan Stock Exchange Association Limited[35]. From the preceding discussion it is clear that although stock markets in the region are not new, their role in the economic development of the region remained meagre until the governments of the respective countries started the process of liberalisation (Gunasekarage and Power, 2001).

The region has witnessed a large number of crises since the countries were granted independence from the UK. For example, relations between India and Pakistan have remained tense for most of the last 60 years due to the Kashmir issue[36]. Indeed, the two countries have gone to war three times since independence (Khan and Khan, 2003). In addition, there was cross-border tension between India and Sri Lanka over the Tamil separatists (of Indian extraction) who wanted independence for the Northern part of the island (Khan and Khan, 2003). As a result, the stock markets in the region remained small, underdeveloped and relatively illiquid; not only was investment by developed country investors viewed with suspicion but equity ownership by nationals from neighbouring countries was strictly prohibited[37].

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[34] In the early 1980's, a second exchange emerged in Sri Lanka, known as the Stock Brokers Association, (Asian Stock Market Fact book, 1994-1995). It merged to form the Colombo Stock Exchange in the late 1980s.

[35] It was renamed the Dhaka Stock exchange in 1964 (Asian Stock Market Fact book, 1994-1995).

[36] Before 1947, India and Pakistan was a combined Indo-Pak subcontinent. After partition, on the basis of the Two-Nation Theory, Muslim majority provinces became Pakistan while Hindu majority provinces became India. Kashmir is a Muslim majority area, but was left as part of India. It's "ownership" is still disputed because of the fear of the two countries. Pakistan fears that if this Muslim majority province remains a part of India, it will create a threat to the existence of Pakistan. On the other hand, India fears that giving up Kashmir will threaten its secular construct and will result in separatist tendencies (Desai, 2010).

[37] For example, having struggled for political independence from a colonial power in the late 1940s, the independent-minded legislators in Sri Lanka were concerned that their financial sovereignty would be

Following the process of liberalisation, the markets have performed well and the number of listed companies has increased significantly. The four markets went through a process of liberalisation in the early part of the 1990s which encouraged more foreign investors to invest in the region (see Section 2.5). A period of political stability and peace among the countries also attracted more foreign investment to the region. Countries entered into regional trade and cooperation agreements such as the South Asian Association for Regional Cooperation (SAARC) in 1985; as a result, various trade and financial sector reforms were introduced such as the South Asia Free Trade Area (SAFTA) in 2004 and SAFE) in 2000[38].

The exchanges are now fully automated with share trading and settlement taking place online; the minimum settlement period is T+2 in India and Pakistan and T+3 for Bangladesh and Sri Lanka. Securities trading at the different exchanges vary depending upon the nature of the exchange. In India, the securities traded include equities, corporate bonds, government securities, T-Bills, commercial paper, exchange-traded funds, mutual funds, warrants, debentures and derivatives (South Asian Financial Markets Review, 2010). In Pakistan, equities, debt, and stock and index futures are currently traded (South Asian Financial Markets Review, 2010). In Bangladesh, the securities are limited to equities, mutual funds and corporate securities only, whereas in Sri Lanka only equities, corporate bonds, warrants and debentures are traded (South Asian Financial Market Review, 2010).

threatened by foreign ownership of domestic companies; hence, they introduced laws to create a purely domestic stock market (Asian stock market fact book, 1994-1995).

[38] In these agreements, the four countries of Bangladesh, India, Pakistan and Sri Lanka are all members, together with Bhutan, the Maldives and Nepal.

Table 2.7 provides summary details about the stock exchanges in the four countries. Information about the main indices, regulatory bodies and the number of exchanges in each South Asian country is provided. An analysis of this table reveals that there are 22 different stock exchanges in India while there are only three, two and one in Pakistan, Bangladesh and Sri Lanka, respectively. All four countries have a Securities and Exchange Commission body for regulating the activities of the stock markets; in each country, this body is typically under the control of the Ministry for Finance. All four countries have an automated share trading system, although each system has different trading and settlement procedures.

Table 2.8 shows summary statistics for the four South Asian markets. A visual inspection of this table reveals that India is the largest market in the region in terms of the number of listed companies. However, the values for this measure have varied from year to year. For example, the highest number of Indian companies listed was in 2000 while the lowest was in 2004. Despite this variability, the number of companies listed on the BSE is greater than the other three exchanges combined. Pakistan had the second largest number of quoted companies in the region while Bangladesh and Sri Lanka are very similar in size. Turnover ratios show that equities in India and Pakistan were more actively traded than in their counterparts in Bangladesh and Sri Lanka. In fact, Sri Lanka reported the lowest turnover ratio of only 11.0 per cent in 2000; in this country, investors did not actively alter their portfolios of equities during that year.

According to Standard and Poor's (2009), Bangladesh was ranked eighth in the world according to its stock market performance in 2008, while Sri Lanka ranked 57$^{th}$, and India and Pakistan ranked 71$^{st}$ and 72$^{nd}$, respectively. Similarly, in a ranking of the world's stock markets according to turnover, Bangladesh was ranked 4th with a turnover ratio of 212.6 per cent, India was ranked 12th with a turnover ratio of 119.3 per cent and Pakistan was ranked 24th with a turnover ratio of 82.9 per cent; these three markets were among the top 25 markets in the world in terms of their turnover ratios. Sri Lanka was ranked 59th with a turnover ratio of 14.2 per cent. These figures suggest that three of the region's stock markets performed well in 2009, among the 96 emerging markets considered by Standard and Poor's (2010).

**Table 2.7: Historical Developments of South Asian Stock Exchanges**

| **Country** | | **Bangladesh** | **India** | **Pakistan** | **Sri Lanka** |
|---|---|---|---|---|---|
| Name Of Exchange | | Dhaka Stock Exchange (DSE) | Bombay Stock Exchange (BSE) | Karachi Stock Exchange (KSE) | Colombo Stock Exchange (CSE) |
| Year of Establishment | | April 28, 1954 | 1875 | 1947 | 1896 |
| No. of Exchanges | | 2 | 22 | 3 | 1 |
| Major Indices | | DSE General Index AB | S&P CNX 500 | KSE 100 | CSE Milanka |
| Market Liberalisation | | 1991 | 1992 | 1992 | 1991 |
| Types of Securities | | Equities, Mutual Funds, Corporate Securities | Equities, Corp. bonds, G-sec, T-Bills, Commercial paper, ETFs, Mutual Funds, Warrants, Debentures , Derivatives | Equities, Debt, Stock and Index Futures | Equities, Corporate Bonds, Warrants , Debentures |
| Trading System | | DSE Automated Trading System, HP NonStop S series | BSE On-line Trading (BOLT) | Karachi Automated Trading System (KATS) | CSE Automated Trading System |
| Settlement time | | T+3 | T+2 | T+2 | T+3 |
| Regulatory Agency | | Securities & Exchange Commission (SEC) | Securities and Exchange Board of India (SEBI) | Securities & Exchange Commission of Pakistan (SECP) | Securities & Exchange Commission of Sri Lanka (SEC) |
| Entry and Exit to the Markets | | Free entry and exit to and from the market | Relatively free entry, with some restrictions on repatriation of income and capital | Free entry and exit to and from the market | Relatively free entry and exit |
| Withholding Taxes | Interest | 20.00 | 15.00 | 10.00 | 10.00 |
| | Div: (%) | 15.00 | 0.00 | 10.00 | 10.00 |
| | CapGain | 0.00 | 20.00 | 0.00 | 0.00 |

Sources: South Asian Financial Markets Review (2010), Standard and Poor's (2009) Asian stock market fact book, 1994-1995) http://www.dsebd.org/, http://www.bseindia.com/,http://www.kse.com.pk/, http://www.cse.lk/. The table shows key developments in the history of the four South Asian stock exchanges of Bangladesh, India, Pakistan and Sri Lanka.

**Table 2.8: Summary Statistics of South Asian Stock Markets, 1999-2008**

| | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Number of Listed Companies** | | | | | | | | | | | |
| Bangladesh | 211 | 221 | 230 | 239 | 247 | 250 | 262 | 269 | 278 | 290 | 236 |
| India | 5863 | 5937 | 5795 | 5650 | 5644 | 4730 | 4763 | 4796 | 4887 | 4921 | 4955 |
| Pakistan | 765 | 762 | 747 | 712 | 701 | 661 | 661 | 652 | 654 | 653 | 629 |
| Sri Lanka | 239 | 239 | 238 | 238 | 244 | 245 | 239 | 237 | 235 | 234 | 231 |
| **Market Capitalisation ($USm)** | | | | | | | | | | | |
| Bangladesh | 865 | 1186 | 1145 | 1193 | 1622 | 3317 | 3035 | 3610 | 6793 | 6671 | 7068 |
| India | 184605 | 148064 | 110396 | 131011 | 279093 | 387851 | 553074 | 818879 | 1819101 | 645478 | 1179235 |
| Pakistan | 6965 | 6581 | 4944 | 10200 | 16579 | 29002 | 45937 | 45518 | 70262 | 23491 | 33239 |
| Sri Lanka | 1584 | 1074 | 1332 | 1681 | 2711 | 3657 | 5720 | 7769 | 7553 | 4326 | 8133 |
| **Market Capitalisation as a % of GDP** | | | | | | | | | | | |
| Bangladesh | 1.9 | 2.5 | 2.4 | 2.5 | 3.1 | 5.8 | 5.0 | 5.8 | 9.9 | 8.0 | N/A |
| India | 41.5 | 32.4 | 23.1 | 25.7 | 46.5 | 55.7 | 68.3 | 89.5 | 154.6 | 54.4 | N/A |
| Pakistan | 11.9 | 10.7 | 6.9 | 14.3 | 20.1 | 30.2 | 41.9 | 35.7 | 49.2 | 14.9 | N/A |
| Sri Lanka | 10.1 | 6.6 | 8.5 | 10.2 | 14.9 | 18.2 | 23.4 | 27.5 | 23.4 | 12.0 | N/A |
| **Trading Value ($USm)** | | | | | | | | | | | |
| Bangladesh | 789 | 768 | 741 | 666 | 327 | 890 | 1000 | 943 | 4746 | 9240 | 14601 |
| India | 278828 | 509812 | 249298 | 197118 | 284802 | 379085 | 443175 | 638484 | 1107550 | 1049748 | 1088889 |
| Pakistan | 21057 | 32974 | 12455 | 26030 | 66598 | 73872 | 140996 | 126560 | 100452 | 54359 | 23527 |
| Sri Lanka | 209 | 144 | 153 | 318 | 769 | 582 | 1138 | 1003 | 966 | 1022 | 885 |
| **Stock Traded Turnover Ratio (%)** | | | | | | | | | | | |
| Bangladesh | 83.4 | 74.4 | 64.8 | 57.1 | 23.2 | 36.1 | 32.2 | 28.8 | 92.3 | 137.3 | 212.6 |
| India | 192.6 | 308.2 | 191.4 | 165.0 | 138.5 | 115.5 | 93.6 | 94.4 | 83.4 | 85.2 | 119.3 |
| Pakistan | 345.2 | 475.5 | 226.8 | 346.2 | 497.4 | 322.6 | 375.7 | 276.1 | 171.9 | 115.9 | 82.9 |
| Sri Lanka | 12.9 | 11.0 | 13.2 | 21.3 | 34.7 | 18.4 | 23.7 | 14.8 | 12.7 | 17.2 | 14.2 |

Source: Standard and Poor's (2009, 2010). The table shows summary statistics of the four South Asian stock markets of Bangladesh, India, Pakistan and Sri Lanka over the eleven-year period 1999-2009. In particular, the table shows the number of listed companies, market capitalisation information, trading value and turnover for the Dhaka stock exchange, the Bombay stock exchange, the Karachi stock exchange and the Colombo stock exchange.

Table 2.9 shows summary data for the S&P /IFCG Indices for the four countries included in the study. The Price to Earnings (P/E) ratio, Price to Book Value (P/BV) ratio and Dividend Yield (%) are provided for each year from 1999 to 2008. A visual inspection of this table for 2008 shows that the typical share in Bangladesh had a very high P/E multiple (21.0), a high P/BV ratio (3.5) and a low dividend yield (1.2 per cent); all these values suggest that equity prices in Bangladesh were high relative to company fundamentals. By contrast, equity prices seemed relatively lower in Sri Lanka resulting in the average company having a low P/E ratio (5.4); a low P/BV (0.8) and a high dividend yield (4.3 per cent). Perhaps most surprisingly, the poorest performing equities in 2008 were located in Pakistan; the P/E ratio, P/BV and dividend yield values for companies in this country were 3.0, 0.8 and 11.8 per cent, respectively, presumably because of the global financial crisis (Bhaskaran, 2009) and the political instability following the assassination of the former Prime Minister Mrs Benazir Bhutto, (*Financial Times*, 2 January, 2008).

What is apparent from Table 2.9 is that the recent global financial crisis adversely affected all four countries in the region (Bhaskaran, 2009). Between 2007 and 2008, P/E and P/BV ratios declined and dividend yields increased. This reversal interrupted an upward (downward) trend that had been apparent in the P/E and P/BV (dividend yield) ratios since 2001. Thus, the performance of the equity indices in these exchanges had been improving but this improvement has been halted. However, what is apparent from Table 2.9 is that the four countries have been affected differently by the recent financial crisis.

**Table 2.9:_Summary Data for the South Asian Markets (S&P/ IFCG Indices)**

| Countries | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|---|---|---|---|
| P/E Ratio | | | | | | | | | | |
| Bangladesh | 8.6 | 12.4 | 7.1 | 7.0 | 7.2 | 17.1 | 16.1 | 16.9 | 29.2 | 21.0 |
| India | 22.0 | 14.8 | 12.3 | 15.4 | 20.6 | 18.9 | 20.7 | 20.9 | 33.0 | 8.6 |
| Pakistan | 13.2 | -117.4 | 7.5 | 10 | 9.5 | 9.9 | 13.1 | 10.8 | 15.3 | 3.0 |
| Sri Lanka | 6.6 | 5.2 | 14.4 | 15.6 | 15.0 | 18.1 | 23.6 | 15.4 | 12.1 | 5.4 |
| P/BV Ratio | | | | | | | | | | |
| Bangladesh | 1.3 | 1.8 | 1.0 | 1.0 | 1.1 | 2.6 | 2.2 | 2.3 | 4.3 | 3.5 |
| India | 3.1 | 2.5 | 2.0 | 2.6 | 3.9 | 3.7 | 5.5 | 5.3 | 8.4 | 1.7 |
| Pakistan | 1.4 | 1.4 | 0.9 | 1.9 | 2.3 | 2.6 | 3.5 | 3.2 | 4.7 | 0.8 |
| Sri Lanka | 1.0 | 0.7 | 0.9 | 1.1 | 1.6 | 1.9 | 2.6 | 2.4 | 1.9 | 0.8 |
| Dividend Yield (%) | | | | | | | | | | |
| Bangladesh | 4.7 | 5.2 | 5.9 | 5.9 | 5.1 | 1.9 | 1.0 | 1.1 | 0.5 | 1.2 |
| India | 1.1 | 1.5 | 2.0 | 2.3 | 1.6 | 1.6 | 1.2 | 1.0 | 0.7 | 2.2 |
| Pakistan | 5.7 | 6.2 | 12.5 | 9.2 | 7.5 | 7.0 | 2.5 | 4.0 | 3.3 | 11.8 |
| Sri Lanka | 6.4 | 8.0 | 6.2 | 3.1 | 3.6 | 4.7 | 2.5 | 1.8 | 2.3 | 4.3 |

Source: Standard and Poor's (2009). The table shows summary data for the four South Asian stock markets of Bangladesh, India, Pakistan and Sri Lanka over the ten-year period 1999-2008. In particular, the table details the Price to Earnings (P/E) ratio, the Price to Book Value (P/BV) ratio, and the Dividend Yield.

While Pakistani and Sri Lankan equities seem to have witnessed large price falls such that P/BV ratios are now less than 1.0, shares of Bangladeshi companies were relatively unscathed. Thus, while the four stock exchanges are geographically close and share a common colonial heritage, their equities appear to behave in a very different fashion. Therefore, a study of the behaviour of the equity prices in these different countries seems warranted. Such a study is conducted in the current thesis.

### 2.7: Conclusion

From the discussion in this chapter, a number of findings emerge about the economies of the four countries studied in the current thesis in general and the stock markets in particular. The stock exchanges of the region seem to fit the criteria set by various researchers and the IFC for defining an emerging market. The emerging markets of South Asia have been relatively attractive for foreign investors in the recent past. The regional exchanges are updating their technology in order to cope with the increasing number of transactions associated with this influx of foreign investors and the larger trading activity by domestic investors. The liberalisation of the stock markets and the structural reforms which governments have introduced appear to have enhanced the performance of the stock markets. The recent increase in the flow of foreign portfolio investment and foreign direct investment has indicated that the economies are attractive to foreign investors. Regional cooperation in the development of the stock markets is progressing in order to bring the region parallel with the developed markets of the world.

# Chapter 3

# Review of the Literature

### 3.1: Introduction

This chapter discusses the EMH as well as Modern Portfolio Theory (MPT) and reviews the empirical studies that have employed various quantitative methods to examine these theories in developed as well as emerging stock markets. In terms of the EMH, the chapter focuses on empirical research that has examined the weak form of the EMH using various econometric techniques. The substantive literature shows that most studies in this area have been conducted using data from developed countries such as the US and UK while relatively little is known about emerging stock markets, especially those in South Asian countries. Therefore, this chapter reviews literature which will include studies from both developed and emerging markets but it will emphasise investigations about emerging stock markets particularly in the South Asian region.

Most studies of emerging markets which investigate the weak form of the EMH have used data for individual countries and employed standard statistical analyses such as serial correlation tests, unit root tests and variance ratio tests – especially those of South Asian region[39]. In addition, to the best of the researcher's knowledge, no study has analysed the performance of stock markets in this region by employing more sophisticated econometric techniques such as those used in the current thesis. Thus, one of the contributions of this thesis is an examination of the weak form of the EMH by employing state-of-the art econometric techniques such as

[39] In most of the previous studies, the main statistical tests employed included the serial correlation test, the variance ratio test and the runs test. The serial correlation test examines the relationship between price changes in a current period with price changes in a previous period; according to the weak form of the EMH, the correlation between these prices changes should be zero. The variance ratio tests exploit the fact that the variance of *N* increments of a random walk is linear in *N*; the variance of yearly sampled returns must be 12 times as large as the variance of monthly sample returns if the share prices are generated by a random walk. It compares the variance of price changes over different intervals to determine if the series behave as a random sequence of numbers. Finally, the runs test is a non-parametric test that examines whether or not a pattern is present in the signs of share price changes and, if it were the case would reject the weak form efficiency.

multivariate cointegration analysis, Vector Error Correction Model (VECM) analysis, Granger Causality tests, Generalised Impulse Response Function investigations, variance decomposition analysis, multivariate regression analysis, and the multivariate Generalised Autoregressive Conditional Heteroscedasticity model of Baba, Engle, Kroner and Kraft (GARCH-BEKK), proposed by Engle and Kroner (1995). The results from the application of these techniques should shed some light on the efficiency of stock markets in the region as well as generating insights for international investors looking to diversify risk by investing within the region. Therefore, a review of the literature on stock market efficiency and portfolio diversification is included in the current chapter.

From the perspective of modern portfolio theory numerous advantages have been documented by researchers attempting to examine international investment in emerging markets[40]. One of the main benefits arises from the lower correlations among equities from different countries or geographical regions; returns from developed countries tend to have relatively high correlations. The lower return correlations among emerging markets have caused investors to consider international portfolios due to the possibility of increased risk reduction and return enhancement (Harvey, 1995; Middleton et al., 2008). However, in practice, investors still tend to invest less in these markets due to a bias towards investment in their home country and the barriers associated with these markets (Mobius, 1994; Hellier et al., 2000; Chan et al., 2005).

[40] The development of portfolio theory by Markowitz (1952) promoted the goal of mean-variance efficient portfolio diversification within a domestic context. According to Markowitz (1952), portfolio risk can be reduced by combining uncorrelated securities. However, in the case of domestic investment, the securities of various companies may not remain uncorrelated, because of economic policies which affect all firms and industries within a specific country. National economic policies tend to increase the correlation among the securities of firms (and their returns) because all companies will be influenced to some extent by the same macroeconomic variables; hence there will be fewer benefits from diversification (Levy and Sarnat, 1970). This has led investors to consider international diversification; because different countries of the world are at different stages of the business cycle, correlations may be less than one and therefore, international investment may offer investors further opportunities for risk reduction (Solnik et al., 1996).

The focus of the more recent literature has shifted in favour of cointegration and VECM analysis for investigating long-term relationships, along with the short-term dynamics, among global equity markets. Evidence of cointegration would mean that stock market prices tend towards equilibrium levels in the long-run, and hence, there is less diversification potential for international diversification among international investors. In addition, Granger (1986) has argued that cointegration among markets may violate the weak form of the EMH. When markets are cointegrated, there should be Granger-Causality in at least one direction which would indicate predictability of share price changes in one market from the historic price information in another market (Chan et al., 1997).

The remainder of this chapter examines a variety of topics which are relevant for the current thesis. Section 3.2 presents a brief overview of the EMH while Section 3.3 outlines various studies which have investigated whether emerging markets are becoming more integrated. This section also discusses the effect of any such integration on the diversification benefits available as well as market efficiency which may exist in emerging markets. The relationship among various macroeconomic variables and share returns in emerging markets is discussed in Section 3.4. Section 3.5 outlines the relevant literature which has examined stock market returns and volatility spillovers. Section 3.6 highlights the gains from international portfolio diversification. This section discusses the putative benefits from emerging markets. Finally, Section 3.7 provides a brief conclusion of the chapter.

### 3.2: An Overview of the Efficient Market Hypothesis

Prior to the 1950s, both academics and practitioners were of the view that economic variables and financial statement information could be used to predict the progress of equity prices (Bodie et al., 1996)[41]. Active investment was generally considered to outperform the market (Arnold, 2008). However, in 1953, Maurice Kendall studied price variations for 20 countries over a period 1928-1938. Weekly data were used and serial correlation analysis was employed to test the null hypothesis that share price changes occur in a random fashion. He used a lag length of 29 weeks to test the hypothesis of randomness in share prices and found that current as well as previous share price changes were not correlated. Hence, the null hypothesis of randomness was not rejected. Mandelbrot (1963) and Samuelson (1965) followed the pioneering work of Kendall and demonstrated that share price changes occur in an unpredictable manner. These studies resulted in the development of the Random Walk Hypothesis (RWH) which later provided the basis for the EMH. According to Fama (1965, p.35):

> "The theory of random walk in stock prices actually involves two separate hypotheses; (i) successive price changes are independent. ..... the probability distribution for the price change during time *t* (current price) is independent of the sequence of price changes during previous time periods and (ii) the price changes confirms to some probability distribution".

Fama (1965) argued that if both these hypotheses were correct, then share prices change in a random fashion. Under the situation when both hypotheses hold, forecasting future price changes based on historical share price data should not be profitable. In such a situation, there should be

[41] They assumed that the behaviour of stock market prices over time was assumed to reflect the prospects of companies which could be gleamed from the current performance of the company and the economy (Bodie et al., 1996).

no correlation between current and historical share prices and future price changes cannot be predicted from the available share price data.

The discovery that share price changes appeared random subsequently resulted in the development of the EMH; this hypothesis was proposed by Eugene Fama in 1965. Fama (1970) defined an “efficient market” as one “in which prices always fully reflect all available information” (p. 383). According to this definition, share price movements should be unpredictable and no investor should have the opportunity to earn consistent abnormal returns over a period of time. Indeed, if share price movements were predictable, that would indicate that stock markets were inefficient, and that all available information was not already reflected in share prices. Therefore, only the arrival of new information to the markets should cause share prices to change. As new information is published in a random fashion, equity prices should be unpredictable from historic price information.

In the academic literature, three types of efficiency have been identified: allocative efficiency, operational efficiency and pricing or informational efficiency. According to Pike and Neale (2006), a stock market is allocationally efficient when it directs funds to the most productive ventures. A market is operationally efficient when investors can trade shares at low levels of transaction costs due to competition between market makers and brokers (Samuels et al., 1995). The most important concept of efficiency for the purpose of the current thesis is pricing or informational efficiency. This refers to the extent to which available information is built into the structure of share prices. In such a market, investors can only earn a return on equities which is appropriate for the risks associated with those shares.

Fama (1970) categorised informational efficiency into three groups. The three forms of efficiency are: weak form, semi strong form and strong form. The weak form of the EMH suggests that current share prices reflect all historical price information. According to this form of the EMH, investors should not be able to earn abnormal returns consistently by trading on the basis of past share price data. Stock market prices should fluctuate randomly and no one should be able to predict future price movements by analysing trends in past returns. Share prices should follow a random walk.

The semi-strong form of the EMH states that current market prices reflect not only all historical price information, but all publically available information as well. For example, published accounting reports, dividend and profit announcements as well as news of stock splits and more general economy – wide information (Ball and Brown, 1968; Fama, 1970) all affect share price movements. The semi-strong form of the EMH postulates that shares prices should adjust to new public information quickly and correctly. Analysts in the market should therefore not be able to beat the market by earning consistent abnormal returns using public information.

The strong form of the EMH states that shares prices fully reflect all relevant information - even if it is privately held. It therefore suggests that prices reflect information including past price data, public news items and private details such as insider information. In such a situation, the market price reflects the ‘true’ value of the shares based on the underlying future cash flow. It suggests that, despite insiders having more information about the company than outside investors, abnormal returns cannot be earned because if they try to exploit this advantage, it will cause prices to move towards their new equilibrium level.

In the current thesis, the weak form of the EMH is investigated in the four emerging stock markets of South Asia. In particular, the thesis investigates whether share prices in the four markets of Bangladesh, India, Pakistan and Sri Lanka are predictable from their own past price changes as well as from price changes in other markets of the region. In addition, the thesis examines whether share price changes are predictable from changes in local and global macroeconomic variables. Finally, the interdependence among the markets is further investigated by looking for return and volatility spillovers among the markets. The relevant literature is discussed in more detail in subsequent sections.

### 3.3: Emerging Stock Market Integration and the Implications for Investment

There are a number of strands to the existing literature on stock market integration. These strands have focused on various markets and sample periods with different frequencies of data; they have used different econometric techniques and interpreted their results from various perspectives. Baillie and Bollerslev (1989) have argued that the use of returns data might result in a loss of important information when prices among markets are cointegrated. This observation calls the results of studies which use an ARCH- type methodology for analysing linkages among returns into question (Chan et al., 1992; Lin et al., 1994; Booth et al., 1997). As a result, recent studies have used price data and employed cointegration techniques to study integration amongst markets.

Among the first studies to analyse integration using this approach were Taylor and Tonks (1989), Chan et al. (1992) and Arshanapali and Doukas (1993); these studies employed the Engle and Granger two-step procedure of cointegration (Engle and Granger, 1987) and examined integration among a pair of markets in a bivariate system. Kasa (1992) was the first to use a multivariate system to investigate whether stock market prices were cointegrated. He investigated the long-run relationship among stock market indices for the US, Canada, Germany, Japan and the UK. He found a single common factor which drove the five markets into equilibrium in the long-run.

A number of researchers have adopted Kasa’s (1992) multivariate cointegration framework for different regions and applied it in different markets (Huang et al., 2000, Chen et al., 2002; Gilmore and McManus, 2002, Masih and Masih, 2002, 2004; Yang et al., 2003, Syriopoulos, 2004, Phylaktis and Ravazzolo, 2005; Diamandis, 2009). These researchers have examined the level of integration among various emerging and developed markets and found mixed results. For example, Gilmore and McManus (2002) discovered no long-run relationship between US equity prices and those of three Central European markets - the Czech Republic, Hungary and Poland - using the Johansen cointegration method. Syriopoulos (2004) extended the sample of Central European stock markets studied and included Slovakia along with Poland, the Czech Republic and Hungary. He found one cointegrating vector among the equity prices of these markets and those of Germany and the US.

Recent studies have focused on regional blocs of markets such as the European Union (EU), the Association of South East Asian Nations (ASEAN) and the area covered by the North American Free Trade Agreement (NAFTA). They have documented that integration among these markets increased after the establishment of the trading blocs. For example, Phengpis and Apilado (2004) found that the stock markets of the European Economic and Monetary Union (EMU) countries were more strongly integrated as compared to their non-EMU counterparts[42]. The authors argued that economic ties among the countries contributed to the integration of these countries' stock markets[43]. Using daily, weekly and monthly data covering both the pre- and post-NAFTA periods, Aggarwal and Kyaw (2005) concurred with this view. They examined the NAFTA countries of Canada, Mexico and the US for the period 1988-2001[44]. Their results indicated that the markets were cointegrated in the post-NAFTA period only. More recently, Click and Plummer (2005) analysed stock market integration among the ASEAN countries[45]. Using daily and weekly data over the period from July 1998 to December 2002, they estimated a total of 15 VAR models for different currencies, data frequencies and lag orders. Their results were consistent for all models, and indicated that a single cointegrating vector was present irrespective of the model specification employed. One issue with their analysis was the time period studied; only four and a half years of data were tested. Any analysis of long-run equilibrium relationships probably requires a longer time period (Aggarwal and Kyaw, 2005).

From an interpretational perspective, the literature on stock market integration can be split into two main categories. First, various researchers have argued that stock market integration may have implications for portfolio diversification. For example, Chen et al. (2002), Gilmore and McManus (2002), Narayan et al. (2004), Syriopoulos (2004), Lamba (2005), Phylaktis and Ravazzolo (2005) and Diamandis (2009) have suggested that integrated markets offer limited diversification potential for international investors. Second, MacDonald and Power (1994), Chan

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[42] In the EMU countries group, France, Germany, Italy, the Netherlands and Spain were considered whereas in the non-EMU group, Australia, Hong Kong, Japan, Singapore and Switzerland were considered. In addition, the US and the UK were included to investigate the relationship of these markets with the world developed markets.
[43] By contrast, Syriopoulos (2007) found that a single cointegrating vector exited amongst the countries both pre- and post-EMU.
[44] The NAFTA agreement was passed in November 1993 (Aggarwal and Kyaw, 2005).
[45] They investigated the five founding members of ASEAN countries for integration including: Indonesia, Malaysia, the Philippines, Singapore and Thailand. ASEAN now also includes the countries of Brunei Darussalam, Cambodia, Laos, Myanmar and Vietnam.

et al., (1997), Liu et al., (1997), Yuhn (1997), Huang et al. (2000), Laopodis (2004) and Diamandis (2009) have highlighted that if asset prices in various markets are cointegrated, this violates the weak form of the EMH because price changes in one market will be significantly influenced by lagged price changes in another market; these lagged price changes may be used to predict the current price changes in the first market via any error correction which may exist in order to bring the market into equilibrium over the long-run. Studies in both of these areas are discussed in more detail below.

Portfolio theory suggests that risk can be minimised by investing in various securities of different countries. A number of researchers have documented that the inclusion of an emerging market component into an investment portfolio can increase returns while lowering risk as compared to a developed markets-only strategy (Divecha et al., 1992; Speidell and Sappenfield 1992; Wilcox 1992; Errunza 1994). One reason for any increased returns is the lower correlation and weak economic linkages among these markets[46]. Hung and Cheung (1995) argued that the presence of cointegration among markets may limit the benefits from international portfolio diversification. Specifically, they stated that:

> "The benefit [from international portfolio diversification], however, is limited when national equity markets are cointegrated because the presence of common factors limits the amount of independent variation. Cointegration among national equity markets implies that there are fewer assets available to investors than a simple count of the number of stocks. Moreover, cointegration would also mean Granger – Causality in levels and hence would be suggestive of inefficiency", (p. 281).

[46] Lessard (1976) argued that the extent of benefits from international diversification depend on the level of integration and segmentation of the markets. The author argued that in the case of integrated markets, the benefits from diversification would be the reduction in diversifiable risk only; whereas in segmented markets, the gains would be greater as some of the previously undiversifiable risk became diversifiable. In addition, Chiou et al. (2009) argued that though integration among international financial markets was increasing gradually, emerging markets are still more segmented than their developed markets counterparts.

In the current thesis, with four stock market variables, the number of common trends ($n - r$) can range from one to four, and this range spans a continuum from perfect integration ($n - r = 1$) to complete segmentation ($n - r = 4$). When stock markets are not cointegrated, four common trends should exist, which would imply that the four markets are segmented and not linked economically. However, if the markets are cointegrated in an econometric sense, links will exist between them in an economic sense. When $n - r = 0$ ($r = n$) the results will show full rank which implies that there are no common stochastic trends between the price indices and cointegration is not defined. If $n - r = n$ ($r = 0$), there is no cointegration and both long- and short-run diversification benefits will be available. If $n - r > 1 < n$, the results will indicate a reduced rank where there is more than one common stochastic trend. It will indicate that long-run integration among the stock markets is not complete although there is some evidence of integration; hence, some benefits from diversification may still remain. If $n - r = 1$, one common stochastic trend exists and the market is in equilibrium in the long-run; hence, no long-run gains from diversification will exist although short-run benefits might be available (Kasa, 1992; Fraser and Oyefeso, 2005).

A number of researchers have investigated the level of integration among emerging markets and its impact on the benefits from international diversification **(**Chen et al., 2002; Gilmore and McManus, 2002; Yang et al., 2003; Narayan et al., 2004; Herrero and Wooldridge, 2007). For example, using weekly data of three Central European countries (Czech Republic, Hungary and Poland) and the US over the period 1 July 1995 - 1 August 2001, Gilmore and McManus (2002) used the Johansen cointegration technique to analyse long-run relationships between different share prices and the Granger-Causality test to study the short-run dynamics among equity returns[47]. They concluded that no long-run relationship existed among the stock markets and that a US investor could have full benefit from diversifying into these countries. Chen et al. (2002) examined stock market linkages in six Latin American countries with well-functioning stock markets: Argentina, Brazil, Chile, Colombia, Mexico and Venezuela. They argued that cointegration among the markets limited the benefits from international diversification; the markets moved in equilibrium over the long-run in a similar fashion. The authors found that the returns from these markets were strongly correlated, which implied that shocks in one market had an effect on other markets in the region. Both the Augmented Dickey Fuller (ADF) and the Philips Perron (P-P) tests were used to test for a unit root in the equity price indices of the different countries; the results showed that the price series were non-stationary in levels but stationary in log difference form. Non-stationary series facilitate the use of cointegration techniques. As a result, the authors used the cointegration and VECM analyses for a period ranging from 1 February 1995 to 30 June 2000. Their results suggested that there was a potential for risk diversification in the region until 1999 because no evidence of cointegration was present; after that period, linkages were stronger. For example, a trend towards deregulation, privatisation plans and trade alliances among the countries of the region meant that equity returns moved in a similar fashion after 1999. In the period up to 30 June 2000, there was evidence of fewer linkages and hence greater risk reduction possibilities from investment in the region. Chen et al. (2002) also found that causality test results suggested that price fluctuations in the Mexican market affected most of the other markets in Latin America with the exception of Colombia; this

[47] Cointegration among markets means that the markets behave uniformly in the long-run, and that they come into equilibrium after some time, which suggests that diversification benefits revealed by short-run correlations are overstated (Gilmore and McManus, 2002). Granger Causality tests showed that the Hungarian market Granger causes the Polish market in the short-run and, hence, they behave like one market.

implied that markets in the region were strongly cointegrated with Mexico and, hence, the Mexican market was the most influential during the time period examined.

Using a relatively large sample to look at the effect of a crisis on stock market correlations, Yang et al. (2003) investigated the linkages between ten Asian countries and the US and Japan for the period from 2 January 1995 to 15 May 2001. Their timeframe was split into three different periods: namely, pre-crisis, crisis and post-crisis around the 1997-1998 Asian crises. Cointegration tests indicated that no cointegrating vector existed in the pre-crisis period, whereas two cointegrating vectors existed in both the crisis and post-crisis periods. These results indicated that the financial crisis in the region had changed the level of market integration in Asia. Generalised impulse response function analysis showed that innovations in a particular country's equity returns affected other related countries' markets. Most of the markets were affected after the crisis and the markets responded primarily to shocks in Indonesia and Hong Kong. Almost all markets showed responses to shocks in the US market while the US market showed no response to shocks in these markets. This implied that Asian markets were more responsive to changes in the US market - possibly because of the international role of US investors in influencing emerging market returns (Bessler and Yang, 2003). Surprisingly, Japan had little or no effect on other markets during the three periods studied which suggested that the Japanese market was relatively isolated from the other Asian markets.

Lamba (2005) investigated the short and long-term relationships among three South Asian emerging markets and the developed markets of France, Germany, Japan, the UK and the US[48]. Daily index data were used over the period from July 1997 to December 2003. The ADF and the

[48] The three South Asian emerging markets were India, Pakistan and Sri Lanka. Bangladesh was not included in the investigation.

P-P test results indicated that the price series were non-stationary and were integrated of order one; they were I(1). To investigate the long- and short-term relationships among the markets, Johansen's (1991) cointegration procedure and the VECM were used. The results of the study indicated that the Indian market was influenced by the stock markets of Japan, the UK and the US. By contrast, prices in Pakistan and Sri Lanka were found to be unrelated to the equity values in developed markets. Lamba (2005) suggested that the region was attractive for foreign investors due to its overall lower level of linkages with the developed markets of Japan, the UK and the US[49].

In a recent study, Herrero and Wooldridge (2007) argued that both regional and global integration had taken place in different areas of the world[50]. For example, they suggested that new European Union (EU) members had achieved a substantial level of integration as a result of close linkages with other member countries. There was a lower level of integration amongst Latin American countries, while the integration among Asian markets was in between the two. They used data from 26 emerging markets to test their hypothesis over the period from 1982 to 2006; nine markets were from Asia, 10 from Europe and seven from Latin America[51]. The relationship between national savings and investment was employed to measure linkages among the countries; based on regression analysis, they concluded that emerging markets were not yet

[49] Lamba (2005) reported that the global events of the 1997 Asian crisis and the September, 2001 US terrorist attack had no significant effect on the relationship of South Asian markets with developed markets.

[50] In particular, they categorised integration into three classes: (1) links of emerging markets with other emerging markets in the same region was termed as regional integration in the narrowest sense; (ii) links of emerging markets with developed markets in the same region was termed as regional integration in the broader sense; and (iii) integration of emerging markets with far away major developed markets was referred to as global integration.

[51] Countries from Asia included China, Hong Kong, India, Indonesia, Korea, Malaysia, the Philippines, Singapore and Thailand. The European countries in the study included Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia. Latin American countries included Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela.

integrated into the global financial system[52]. Their findings implied that ESMs still offered diversification potential to international investors. For example, they stated that:

> "The development of regional financial centres in order to take advantage of network externalities appears to be an important means of advancing regional integration, ……regional integration, however, should not be understood as a substitute for global integration", (p.69).

The second strand of the cointegration literature has focused on the integration amongst markets from the perspective of the EMH. These studies followed the argument of Granger (1986), which stated that:

> "If $X_t, Y_t$ are I(1) and cointegrated, there must be Granger Causality in at least one direction, as one variable can help forecast the other. If $X_t, Y_t$ are a pair of prices from a jointly efficient, speculative market, they cannot be cointegrated. If the two prices were cointegrated, one can be used to help forecast the other and this would contradict the efficient market assumption". (p.218)

Hence, the presence of cointegration among share prices violates one of the central tenets of the EMH. Existence of cointegration would mean that price changes of one series are predictable from lagged returns of other securities in the long-run and hence the market cannot be weak form efficient. Following this argument, MacDonald and Power (1994) argued that when prices are cointegrated, Granger – Causality may be present in at least one direction between the price series, which would enable an investor to predict share price changes in the future. They further suggested that this causality might be due to the fact that shares prices do not reflect all available information[53]. Chan et al. (1997) investigated equity prices for 18 countries over a period of 32 years from January 1961 to December 1992. They employed cointegration analysis and the error

[52] They argued that in financially integrated markets there need not be any relationship between saving and investment within a country. They found that the rate of retained saving for domestic investment were higher for emerging markets in comparison to developed markets.

[53] And that there may be variations in expected returns.

correction estimation methods. They documented that share prices were predictable from the error correction estimation. In addition, they reported that, in those cases where markets were not cointegrated, available information must have already been incorporated into the prices of the securities. Specifically, Chan et al. (1997) stated that:

> "If two stock markets are collectively efficient in the long run, then their stock prices cannot be cointegrated. In other words, if two markets are cointegrated, then possible arbitrage profits can be explored". (p. 803)

Liu et al. (1997) examined the Shanghai and Shenzhen stock exchanges of China using daily data for the period 1992-1995. They employed the ADF test, the Engle and Granger (1987) and Johansen (1988) procedures for cointegration and the Granger (1988) causality test in order to examine the relationship between the markets. They concluded that there was a common stochastic trend between the two markets. They found a cointegrating relationship; in fact a bidirectional causality was detected between the two markets. Furthermore, cointegration and causality test results indicated inefficiency in the Chinese markets during the period being examined. Yuhn (1997) used Johansen (1988, 1991) and Johansen and Juselius (1990) cointegration tests for the developed markets of Canada, Germany, Japan, the UK and the US. Based on the results of his study, he concluded that the stock markets of Canada and the US were efficient whereas the stock markets of Germany, Japan and the UK were informationally inefficient over the period under study. Huang et al. (2000) examined the relationship among the developed stock markets of Japan and the US with the South China region[54]. They used daily stock price data over a period from October 1, 1992 through June 30, 1997 and employed cointegration and Granger Causality tests for the examination. They found that no long-run

[54] The South China Growth Triangle (SCGT) includes the stock markets of Shanghai, Shenzhen, Hong Kong and Taiwan.

relationship among the markets existed except for the two Chinese stock exchanges. Their short-run analysis indicated that the US market led the Hong Kong and Taiwanese markets by one day[55]. Hence, they reported that US share price changes could be used to predict share price changes in Hong Kong and Taiwan on the subsequent day. A summary of some important studies in this area is provided in Table 3.1.

Recently, Laopodis (2004) investigated market integration and efficiency in the Athens stock exchange before and after market liberalisation announcements were made. He found that the price index for the Athens stock exchange was not cointegrated with its counterpart for Frankfurt or the S&P 500 index in any post-liberalisation period. He further argued that these results indicated that the markets were weak form efficient. More recently, Diamandis (2009) stated that:

> "Evidence of strong linkages among world capital markets may lead to the rejection of the efficient market hypothesis in the framework defined by Granger (1986) who considers the incompatibility between cointegration of two or more assets prices and the fact that these prices are derived from efficient markets", (p.14).

The implications of cointegration analysis and the VECM for the EMH are outlined in a number of studies documented in the thesis. For example, Huang et al. (2000) suggested that cointegration analysis had implications for the weak form of the EMH; using an Error Correction Model (ECM) they argued that lagged share price changes could be used to predict current share prices in the two Chinese stock markets of Shanghai and Shenzhen. Laopodis (2004) adopted a similar position when he argued that "the efficient market hypothesis postulates that as markets become more open and transparent to the public, the prices of assets should reflect the greater

[55] Huang et al. (2000) argued that previous day price changes in the US market have a positive impact on next day movements in Hong Kong and Taiwan due to the Hong Kong dollar peg with the US dollar and because the high technology industry in Taiwan reflects its counterpart in the US.

availability of information and be more efficiently valued. In other words, as home and global investors have a greater access to the domestic market, the current price of the asset should come to embody all available [historic] information. An efficient market should react only to new information (or news) but given that, by definition, it is unpredictable, price changes in an efficient market cannot be predicted" (p. 104). In his study of European stock markets, Laopodis (2004, p. 104) suggested that "if there is evidence of cointegration between the ASE (Athens Stock Exchange) and either Germany's or the US's equity markets, then it would imply that the ASE (and the other market) are not efficient" (p. 110). He went on to point out that his "results from a series of tests [including a cointegration test] suggested that the Greek equity market was weak-form efficient long before [any liberalisation] announcements were made. Hence, the ASE was operating as a random walk hinting that investors could not systematically engage in profitable ventures because future long-term returns were not dependent on past returns" (p. 121). According to Erdinc and Milla (2009), "the most commonly observed and analysed [form of market efficiency] is the weak-form market efficiency (the information set includes only information on historical returns). Consequently, capital market integration may contradict weak-from market efficiency if one market's movements can be used to predict another market's movements" (p. 110)[56]. Erdinc and Milla (2009) went on to report that a "the world stock index and [indices for] three major EU countries are cointegrated. This implies market inefficiency

[56] This definition of the weak form of the EMH is slightly different from that outlined in Fama (1965, 1970). Specifically, Fama (1970) argued that a market was weak form efficient if current share prices reflected all of that security's own historical price information. According to this form of the EMH, investors should not be able to earn abnormal returns consistently by trading on the basis of past share price data. Laopodis (2004) and Erdinc and Milla (2009) extended this definition to include all historical information and not simply details of a security's own past price values. It is the Laopodis (2004) and Erdinc and Milla (2009) definition of the weak form of the EMH which is employed in the current thesis.

because the past information in one market [can] be used to help predict the price movements in another market. Consequently, the weak-form market efficiency is violated" (p. 117)[57].

[57] Morgan Stanley Capital International (MSCI) index was used as a proxy for world capital market. The three EU countries included France Germany and United Kingdom. The data were studied for the period from January 1991 to September 2006 and cointegration analysis was used for examining linkages among the markets.

**Table 3.1: Summary of Studies Showing Integration Among Stock Markets**

| Author(s) | Countries | Time Period | Sample | Method(s) Used | Key Findings |
|---|---|---|---|---|---|
| **MacDonald and Power (1994)** | UK, companies' data from five sectors. | Jan 1982- June 1990 | Weekly data | Cointegration analysis, Engel and Granger two step procedure and multivariate cointegration analysis. | The bivariate cointegration demonstrated no cointegration in the majority of companies with the FT-All Share Index. The multivariate cointegration showed substantial amount of integration among the companies and hence, inefficiency in the UK market. |
| **Chan, Gup and Pan (1997)** | Australia, Belgium, Canada, Denmark, France, Germany, India, Italy, Japan, Netherlands, Norway, Pakistan, Spain, Sweden, Switzerland, UK and US. | Jan 1961- Dec 1992 | Monthly data | Multivariate cointegration analysis | A unit root was found in the monthly price data of all markets. A small number of stock markets showed evidence of cointegration with others. The number of cointegrating vectors did not increase after the 1987 crash. International diversification may be effective among the markets having no long-run comovements. |
| **Gilmore and McManus (2002)** | Czech Republic, Hungary, Poland and the US. | July 1995- Aug 2001 | Weekly data | Multivariate cointegration analysis and Granger-Causality test | No long-run relationship was found among the European markets as well as with the US. US investors could benefit from diversifying into these countries. In the short-run, the Hungarian market Granger-caused the Polish market. |
| **Lamba (2005)** | France, Germany, India, Japan, Pakistan, Sri Lanka, the UK and the US. | July 1997- Dec 2003 | Daily index data | Johansen cointegration analysis and Vector Error Correction Model | The Indian market was influenced by the developed markets of Japan, the UK and the US. Pakistan and Sri Lanka were relatively less related to the developed markets. The region was found attractive for foreign investors due to lower correlations with the developed markets. |
| **Herrero and Wooldridge (2007)** | 26 markets were investigated; nine Asian, 10 European, and seven from Latin America. | 1982-2006 | Monthly data | Multivariate regression analysis | Emerging markets were not yet integrated into the global financial system. ESMs still offered diversification potential for international investors. They further argued that regional integration increased, but regional integration should not be considered as a substitute for global integration. |
| **Diamandis (2009)** | Argentina, Brazil, Chile, Mexico and the US. | Jan 1998-July 2006 | Weekly data | Johansen multivariate cointegration analysis and variance decomposition | The four Latin American markets and the US were partly integrated. The five stock markets had four common permanent components driving their system in the long-run. There were short-run deviations from the common trends. |

Table 3.1 shows a summary of selected studies that have investigated the integration among stock markets. For each study, the table indicates the countries studied, the time period, the methods used for analysis and the key findings.

### 3.4: Macroeconomic Variables and Shares Returns in Emerging Markets

Numerous studies conducted in developed countries provide results in support of the argument that share prices change with vary in macroeconomic variables. The argument suggests that the intrinsic value of equity shares depends on the present value of dividends which is distributed out of corporate earnings; these earnings are influenced by real economic activities and hence, there should be a relationship between economic variables and share prices[58]. More recently, Flannery and Protopapadakis (2002) have argued that macroeconomic variables are good candidates for determining stock returns, as changes in these variables will affect the firm's cash flows and will also influence the risk adjusted discount rate.

To investigate whether shares returns can be predicted by macroeconomic variables in both the long- and the short-run, many researchers have investigated the relationship between measures such as Gross Domestic Product (GDP), inflation and interest rates and stock market returns, especially for developed markets (Fama, 1981; Chen et al., 1986; Poon and Taylor, 1991). Among these studies, the macroeconomic variables that are commonly investigated include inflation, exchange rates, GDP, the money supply, world industrial production and world inflation as well as stock market returns in developed economies such as the US and the UK[59]. A

[58] Leroy and Porter (1981) and Shiller (1981) argued that macroeconomic variables may affect the discount rate and the ability of the firm to generate cash flows.

[59] Rapach et al. (2005) examined monthly data for the 12 industrialised countries of Belgium, Canada, Denmark, France, Germany, Italy, Japan, Netherlands, Norway, Sweden, the UK and the US over the period 1970-1990, and found that interest rates were the most consistent and reliable macroeconomic variable among these countries. Nasseh and Straus (2000) examined the long-run relationship between stock prices and interest rates, consumer prices, real domestic macroeconomic innovations and international activity for the period 1962-1995 in six European economies: France, Germany, Italy, Netherlands, Switzerland and the UK. They found that industrial production and manufacturing orders were significant factors in explaining long-run movements in stock prices. More recently, Humpe and Macmillan (2009) investigated the relationship between macroeconomic variables and stock prices in the US and Japan and used monthly data over a period from January 1965 to June 2005. They found a long-run relationship between stock prices and industrial production, inflation and the long-term interest rate in the US market. In Japan they found a long-run relationship between stock prices and industrial production and the money supply.

number of studies have found significant relationships between these variables and equity price changes for developed markets. For example, Fama (1981) documented evidence of a strong positive relationship between equity returns and real economic activities such as industrial production, capital expenditures and Gross National Product (GNP), while a negative relationship was found between share returns and inflation in the US market. Following Fama (1981), Chen et al. (1986) documented that macroeconomic variables such as industrial production, changes in the risk premium and variations in the yield curve were significant factors in explaining stock returns. Using quarterly data for Canada, Germany, Italy, Japan and the US, Cheung and Ng (1998) investigated the relationship between stock market indices and macroeconomic variables using the Johansen (1991) cointegration technique[60]. They concluded that changes in stock market indices were cointegrated with various measures of a country's aggregate real economic activity such as its oil price, consumption, money stock and output. In the UK, Poon and Taylor (1991) found that their results were different from those in the US while analysing the same macroeconomic variables and suggested that other economic factors may be responsible for variations in equity returns for the London Stock Exchange.

Others have arrived at a similar conclusion for emerging markets. In emerging markets there is a growing literature which focuses on the relationships between share returns and macroeconomic variables. For example, Harvey (1995a, 1995b), Fifield et al. (2002), Wongbangpo and Sharma (2002), Fifield and Power (2006), Acikalin et al. (2008) and Mehmood and Dinniah (2009) are some of the recent studies that have focused on the relationships between share returns and macroeconomic variables in emerging markets. For example, Harvey (1995a, 1995b) examined

[60] They used macroeconomic variables as a proxy for aggregate economic activity. The variables investigated included real oil prices, real GNP, real money supply and real consumption. They used countries' respective consumer price indexes to convert their nominal variables to real terms.

the influence of a set of global variables in explaining variations in the returns of 21 emerging stock markets over the period 1976-1992[61]. He concluded that these global factors were insufficient for characterising returns in emerging stock markets. This argument was supported by Fifield et al. (2002)[62]. They investigated the extent to which global and local factors affected equity returns of ESMs using data over the period from 1987 to 1996. PCA was employed to distil the different economic variables into key principal components before regression analysis was used to see whether these PCs were associated with share returns for 13 ESMs[63]. A set of commonly researched local and global factors were first analysed using PCA and four local factors were extracted; namely, GDP, inflation, the money supply and interest rates. Two global factors, including world industrial production and world inflation, were also found to be important. These factors were then analysed via regression analysis. The results indicated that local factors were important in explaining stock market returns in India and Turkey whereas global factors were important in Greece, Korea, Mexico, Portugal, Singapore and Thailand[64]. One implication of these results is that integration with the world's developed markets was more pronounced among the latter group of countries whereas the former group of countries was more isolated at the time of the study.

Many researchers have shown that several local or country-specific factors (and, in some cases, global factors) can explain a limited amount of the share price variation in ESMs. One reason for

[61] The global variables investigated included the world equity market return, the return on a foreign exchange index, oil prices, world industrial production and the world inflation rate.
[62] Their results indicated that a mix of local and global variables could only explain up to a maximum of 14.6 per cent of the variation in monthly returns for a sample of 13 emerging stock markets. More recently, Fifield and Power (2006) showed that combining fundamental factors such as market value, dividend yield, the PE ratio and turnover ratios with the local and global variables enhanced the $R^2$ by up to 38.2 per cent in a sample of 11 emerging stock markets.
[63] Chile, Greece, Hong Kong, India, Korea, Malaysia, Mexico, the Philippines, Portugal, South Africa, Singapore, Thailand and Turkey were included in the study.
[64] The results are in agreement with Nasseh and Straus (2000) who argued that share prices are significantly related to domestic and international macroeconomic variables and that domestic and international factor could be used to explain equity prices in the sample countries.

this limited explanation may be that factors other than the economic variables studied lead to changes in share prices. For example, Fifield and Power (2006) studied whether economic factors (local and global)[65] and fundamental factors explained share returns in 11 emerging markets over the ten year period from 1991 to 2000. Six of the countries selected were from Asia while five were from the rest of the world[66]; this allowed the authors to investigate the extent of any inter-regional integration for international investors. Among the fundamental factors considered were market value, dividend yield, the PE ratio and turnover. The results indicated that GDP, inflation, the money supply, interest rates, world GDP and the world market return had an impact on the stock markets of both Asian and non-Asian countries. The results further suggested that local factors were important in explaining equity returns for both regions whereas global factors (fundamental factors) were more important in Asian (non-Asian) stock markets. It seems that Asian stock markets were influenced more by the economic performance of developed countries.

Recently, numerous studies have focused on examining the relationship between macroeconomic variables and stock returns in emerging markets using relatively advanced econometric techniques such as cointegration, VECM and Granger Causality analysis. For example, examining monthly data over the period from 1985 to 1996 for ASEAN-5 countries including Indonesia (JCSPI), Malaysia (KLSE), the Philippines (PSE), Singapore (SES) and Thailand (SET), Wongbangpo and Sharma (2002) investigated whether variations in GDP, inflation, the money supply, interest rates and exchange rates were related to changes in a country's share

[65] Local factors included inflation, exchange rates, GDP, short-term interest rates, the money supply and the trade balance while global factors included world inflation, world GDP, the world market return, commodity prices, oil prices and US interest rates.
[66] Asian countries included Hong Kong, Korea, Malaysia, the Philippines, Singapore and Thailand. Non-Asian countries included Chile, Greece, Mexico, South Africa and Turkey.

price index[67]. Cointegration analysis, Granger causality tests and variance decomposition analysis were used to examine the long- and short-run relationships for the economic variables and the share returns for each country in the region under consideration. The results indicated that there was (i) a positive relationship between share prices and GDP; and (ii) a negative relationship between equity prices and inflation in all five countries over the long run. In the Philippines, Singapore and Thailand, the results indicated a negative long-run relationship between share prices and interest rates whereas the opposite was true for Indonesia and Malaysia[68]. In Indonesia and the Philippines, there was a negative long-run relationship between the money supply and share prices; one reason for this finding may have been the high levels of inflation in some of these countries during the period of study. During the same period, growth in the money supply had a positive impact on equity prices in Malaysia, Singapore and Thailand. The exchange rate was positively associated with share prices in Indonesia, Malaysia and the Philippines whereas the relationship was negative for Singapore and Thailand[69]. The Granger causality tests revealed that there were causal relationships among the variables in all five countries. One implication of these findings is that share prices in these countries may have been predictable from past macroeconomic variables due to the causality detected[70].

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[67] The abbreviations stand for Jakarta Composite Stock Price Index (JCSPI), Kuala Lumpur Stock Exchange Composite Index (KLSE), Philippine Stock Exchange Composite Index (PSE), Stock Exchange of Singapore Index (SES) and Stock Exchange of Thailand Index (SET).

[68] One reason for the varying results in these countries may be because Indonesia and Malaysia are Islamic countries while the other three countries are Christian and Buddhist countries. If money supply increases, inflation rises. Thus money supply and share prices have a negative relationship. However, an increase in money supply decreases interest rates. Thus, money supply and share prices can be positively or negatively related depending upon which effect is greater.

[69] The positive relation between exchange rates and stock prices may have been due to increased exports in the three countries during that period.

[70] In a more recent study, Mehmood and Dinniah (2009) studied the linkages between stock prices and four macroeconomic variables for a period from 1993 to 2002: namely, inflation, industrial production, stock prices and foreign exchange rates. Their sample countries included Australia, Hong Kong, Japan, Korea, Malaysia and Thailand. Cointegration analysis was employed and an error correction model estimated to determine the long- and short-run dynamics between share prices and macroeconomic variables. The results of the Engle-Granger

Investigating whether there was any relationship between four domestic macroeconomic variables (GDP, exchange rates, interest rates and the current account balance) and the Istanbul Stock Exchange (ISE) index, Acikalin et al. (2008) found cointegration and unidirectional causal relationships over the period from 1991 to 2006. They argued that the causal relationship might help predict changes in the ISE using past information on changes in GDP, the current account balance and exchange rates. In addition, according to Ahmed and Imam (2007, p.22):

> "If macroeconomic activity affects stock prices then an efficient stock market instantaneously incorporates all available information about economic variables. In the absence of informational efficiency, participants in the stock market would be able to develop profitable trading rules and can earn above average returns".

Studies which have focused on South Asian countries are fairly dated and have generally examined the countries individually with a relatively small number of variables[71]. For example, Gunasekarage et al. (2004), Ahmed and Imam (2007), Ahmed (2008) and Sohail and Hussain (2009) studied the relationship between economic variables and stock market performance in Sri Lanka, Bangladesh, India and Pakistan, respectively. In addition, all these studies examined the relationship between domestic economic variables and share returns, ignoring the influence of international factors on the share returns in these markets. For example, Gunasekarage et al. (2004) investigated the relationship between domestic macroeconomic variables (the money supply, interest rates, inflation and foreign exchange rates) and the share price index in Sri Lanka. They analysed monthly data over a period from January 1985 to December 2001 by

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cointegration method indicated that share returns were cointegrated with economic variables in all countries except Australia and Malaysia. Multivariate Johansen cointegration tests indicated a long-run relationship between share prices and economic variables for all countries except Malaysia and Thailand. The error correction model suggested a short-run relationship between economic variables and stock prices in Thailand and Hong Kong only.

[71] One exception to this generalisation is Smith and Nandha (2003) which included the four countries of Bangladesh, India, Pakistan and Sri Lanka. However, they examined the relationship between stock prices and exchange rates over the period 1995 to 2001. By employing cointegration analysis and granger causality tests they found no long-run relationship between the two variables for all four markets.

employing cointegration, VECM, an impulse response function and variance decomposition analysis[72]. Their results indicated that there was one cointegrating vector which suggested that a long-run relationship existed between the variables. Their results further indicated that inflation and interest rates had a negative impact on share prices in Sri Lanka whereas money supply had a positive impact on share prices during the period of study. Foreign exchange rates showed no significant association with equity prices which may have been due to the low participation of foreign investors in the Colombo stock exchange during the period examined.

Ahmed and Imam (2007) considered monthly data for the general share price index of the Dhaka Stock Exchange (DSE) and economic variables for an eight year period from July 1997 to June 2005 including: the money supply, the treasury bill rate (91-day weighted average rate), interest rates, GDP and industrial production. Johansen cointegration analysis, VECM modelling and Granger Causality tests were used to determine the long- and short-run dynamics of the relationship between the economic variables and equity prices in Bangladesh[73]. They concluded that no long-run relationship existed between share prices and economic variables in the country for the period under consideration. One possible explanation which they advanced for their results was that the market capitalisation of the Dhaka stock exchange was low and, hence, its impact on the Bangladeshi economy for the period may have been insignificant. They also suggested that factors other than those studied may have been important in explaining the changes in share prices for Bangladesh.

[72] Gunasekarage et al. (2004) argued that most of the variation in the market index was explained by its own innovations, with macroeconomic variables explaining a minor proportion. They argued that including more macroeconomic variables into the analysis would have increased this proportion.

[73] However, the Granger Causality test indicated a unidirectional causal relationship from interest rate changes to the stock market. Ahmed and Imam (2007) argued that stock prices do not immediately reflect changes of macroeconomic factors (interest rate changes).

Ahmed (2008) studied the long- and short-run relationships between the stock market and macroeconomic variables in India over a period of 12 years from March 1995 to March 2007 using quarterly data[74]. Using the Johansen cointegration framework and Granger causality tests, he found a long-run relationship between stock prices and Foreign Direct Investment (FDI), the money supply and the industrial production index. He found that the domestic industry was more important in influencing the stock market than foreign factors because of lower exports. He further argued that stock prices lead economic activities, whereas interest rates lead stock prices in India[75].

Sohail and Hussain (2009) investigated the long- and short-run dynamics between macroeconomic variables and stock prices in Pakistan. Specifically, they examined the relationship between inflation, foreign exchange rates, interest rates, industrial production, the money supply and stock returns for the Lahore Stock Exchange (LSE) over the period from December 2002 to June 2008[76]. The results indicated a negative relationship between inflation and share prices, whereas industrial production, exchange rates and the money supply all had a positive relationship with share prices. A variance decomposition analysis showed that inflation was the most important factor in explaining changes in share prices. A summary of the selected studies is given in Table 3.2.

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[74] The variables included the industrial production index, exports, FDI, the money supply, exchange rates, interest rates, and the NSE nifty and BSE Sensex indices for the Indian market.

[75] More recently, including India as part of a sample of the largest ESMs, Gay (2008) investigated the relationship among stock returns, exchange rates and oil prices for the larger emerging markets of Brazil, Russia, India and China (BRICs) over the period from March 1999 to June 2006. Using the monthly stock market index, exchange rates and oil prices and employing the Box-Jenkins Autoregressive Integrated Moving Average (ARIMA) technique for the analysis, they found no significant relationship between the stock market and exchange rates and oil prices.

[76] The study investigated the relationships between stock returns and macroeconomic variables by using stock index data for the Lahore Stock Exchange (LSE) which is a small market in terms of market capitalisation and the number of listed companies and may not represent the whole economy of Pakistan. In the current thesis, Karachi Stock Exchange (KSE) index data are used which is the biggest exchange of the country.

From this review of the literature, it seems that economic variables and share prices appear to have a causal relationship in many emerging market countries. Although the evidence is less clear cut for South Asian countries, it is especially true for other emerging markets. One reason for this difference may be due to the focus on individual countries with fewer macroeconomic variables investigated than used in the studies for other emerging markets of the world[77]. In addition, most of the previous studies focusing on South Asia have investigated the relationship between stock markets and domestic macroeconomic variables only. By considering a large number of domestic and global variables, and focusing on the four South Asian countries, this thesis examines whether common patterns of return predictability using macroeconomic variable data emerge across countries, or whether the predictive ability of certain macroeconomic variables is particular to only one or a few countries. The current thesis aims to investigate any such relationships in South Asian emerging markets with a relatively recent dataset and examine a large number of both local and international macroeconomic variables.

[77] For example, Gunasekarage et al. (2004) argued that they wanted to use industrial production and GNP data in their analysis but the data were not available on a monthly basis. The data for industrial production are used in the current thesis for analysing the Sri Lankan market along with the three South Asian markets of Bangladesh, India and Pakistan.

**Table 3.2: Summary of Studies Showing the Relationship between Stock Returns and Macroeconomic Variables**

| Author(s) | Countries | Time Period | Sample | Method(s) Used | Key Findings |
|---|---|---|---|---|---|
| **Wongbangpo and Sharma (2002)** | ASEAN-5 Countries, Indonesia, Malaysia, Philippines, Singapore and Thailand. | 1985-1996 | Monthly data | Cointegration analysis, Granger Causality test, Variance decomposition analysis. | Stock prices were positively related to GDP and negatively related to inflation in all countries. They were negatively related to interest rates in Philippines, Singapore and Thailand and positively related in Indonesia and Malaysia. Exchange rates were positively related to stock prices in Indonesia, Malaysia and the Philippines and negatively related in Singapore and Thailand. |
| **Gunasekarage, Pisedtasalasai and Power (2004)** | Sri Lanka | Jan 1985- Dec 2001 | Monthly data | Cointegration, VECM, Impulse response functions, and Variance decomposition analysis | Stock prices were negatively related to inflation and interest rates, positively related to the money supply and no relationship was found with exchange rates. Variance decomposition analysis revealed that most of the variability in stock index returns was due to its own lagged values; a minor portion was explained by economic variables which indicate that other variables may also be important. |
| **Fifield and Power (2006)** | Hong Kong, Korea, Malaysia, Philippines, Singapore, Thailand, Chile, Greece, Mexico, South Africa and Turkey | 1991- 2000 | Monthly data | PCA and multivariate regression analysis | Local factors were important in both Asian and non-Asian countries. Global factors have an impact on Asian markets whereas non-Asian stock markets were affected by fundamental factors like size of the stock market. |
| **Ahmed (2008)** | India | March 1995 to March 2007 | Quarterly data | Johansen cointegration, T-Y Granger causality tests, Variance decomposition analysis and Impulse response function analysis | There is a long-run relationship between stock prices and FDI, money supply and industrial production. The stock market leads economic activities and interest rates lead the stock market. |
| **Mahmood and Dinniah (2009)** | Malaysia, Japan, Korea, Thailand, Hong Kong and Australia | 1993-2002 | Mix of Monthly and Quarterly data | Engle-Granger cointegration, Johansen cointegration and ECM. | A long-run relationship was found between stock prices and macroeconomic variables in all countries except Malaysia. A short-run relationship was found in Hong Kong and Thailand. |
| **Sohail and Hussain (2009)** | Pakistan | Dec 2002-June 2008 | Monthly data | Johansen cointegration, VECM and Variance decomposition analysis | Inflation showed a long-run negative relationship with stock prices whereas industrial production, exchange rates and the money supply had a negative relationship with stock prices. Inflation was found to be the most important factor. |

Table 3.2 shows a summary of selected studies that have investigated the relationship between stock returns and macroeconomic variables. For each study, the table indicates the countries studied, the time period, the methods used for analysis and the key findings.

### 3.5: Return and Volatility Spillovers in Emerging Stock Markets

A number of authors have suggested that spillovers in returns or volatility can have implications for the EMH. For example, Harris and Pisedtasalasai (2006, p.1556) stated that:

> "In an efficient market, and in the absence of time-varying risk premia, it should not be possible to forecast the returns of one stock using the lagged returns of another stock. The finding that there are spillover effects in return implies the existence of an exploitable trading strategy and, if trading profits exceed transaction costs, potentially represents evidence against market efficiency".

According to Chuang et al. (2007), the implications for market efficiency are not limited to spillovers in returns; they suggested that "international investors incorporate into their portfolio selection not only the equity returns correlation structure but also the market volatility interaction; the results [of a study taking account of both return and volatility interactions] can [therefore] shed light on the extent to which investors can benefit from international diversification" (p.312).

This view of Chuang et al. (2007) supports the arguments advanced by King et al. (1994). They argued that an understanding of changes in conditional covariances is potentially useful in deciding on an appropriate set of country weightings when deciding on a global portfolio allocation. Thus, they suggested that not only are spillovers informative about the efficiency of a market but they can have implications for portfolio diversification as well. Li and Majerowska (2008) agreed with this view. They argued that if markets are integrated, an anticipated event in one market will influence not only the return but also the variance of price changes in other markets. An analysis of volatility is therefore important as the mean level of returns in one market may be unaffected by news from another market while the risk of the equities may alter. Any such risk changes need to be factored into portfolio decisions.

Section 3.3 on market integration highlighted how interdependence among the ESMs is less pronounced than linkages among developed markets; it concluded that the lack of complete integration among the ESMs may offer gains for international diversification. Studies that investigate integration among markets generally use share price data. Recently Li and Majerowska (2008) have argued that returns as well as volatility should be used to investigate interactions among the markets. They argued that markets may not be related through the average level of returns but by shocks and volatility transmission. Therefore, shocks and volatility in one market may spread to other markets depending on the linkages among various markets even though the mean level of return may remain unaltered. In this section, the focus is on the literature which has examined volatility spillovers among emerging markets and its effect on market efficiency as well as its implications for portfolio diversification.

A majority of existing research which has investigated inter-relationships among developed and emerging capital markets have used cointegration analysis, error correction models and causality tests with share price data. A review of some of these studies is provided in Section 3.3. Among these studies, some of the more influential investigations for this thesis were Chen et al. (2002), Gilmore and McManus (2002), Masih and Masih (2004), Lamba, (2005) and Diamandis (2009). These studies reported on the presence of cointegration among the stock markets and indicated whether the stock markets under investigation were integrated.

Another strand of the research in this area has concentrated on the transmission of return and volatility shocks throughout international stock markets. Most of these studies have focused on developed markets. For example, Hamao et al. (1990) studied the markets of the UK, the US and Japan, using univariate GARCH in mean models. They found volatility spillovers from the US (New York) to Japan (Tokyo) and the UK (London) stock market, and from the UK stock market to the Japanese stock market. Theodossiou and Lee (1993) used a multivariate GARCH in mean model to analyse markets in Canada, Germany, Japan, the UK, and the US. They found that the US market was the most influential in terms of volatility transmission to other markets in the sample. Koutmos and Booth (1995) examined the asymmetric impact of good and bad news on volatility transmission across the New York, Tokyo and London stock exchanges. They found unidirectional return spillovers from New York to both Tokyo and London and from Tokyo to London. They also found a bidirectional volatility spillover among the three markets.

Kanas (1998) studied volatility spillovers among three European stock markets, namely: London, Frankfurt and Paris. Using daily data for a period from January 1984 to December 1993, the study focused on the pre- and post-1987 stock market crash date. An Exponential Generalised Autoregressive Conditional Heteroscedasticity (EGARCH) model was used to capture any leverage effect in the European markets under examination[78]. Both univariate and bivariate EGARCH extensions were used to analyse spillovers from any two markets to a third market and between any two markets, respectively. Their results indicated ‘reciprocal’ volatility spillovers between London and Paris and between Paris and Frankfurt. Unidirectional spillovers were found from London to Frankfurt as well. In addition, they reported that bad news had a more pronounced effect than good news in volatility spillover effects. They found greater spillovers after the 1987 stock market crash which is consistent with the work of Liu and Pan (1997).

A majority of the previous studies investigating return and volatility spillovers have focused on the transmission of shock spillovers from developed to emerging markets. For example Liu and Pan (1997), Ng (2000), Wang et al. (2005) and Sok-Gee et al. (2010) are some of the many

[78] A leverage effect refers to the effect where stock market volatility tends to be more pronounced in response to bad news than to good news (Kanas, 1998).

studies who found significant spillover effects from the US markets to most of the emerging markets under investigation. In addition, a large number of these studies emphasised unidirectional spillovers by using univariate or bivariate GARCH models. For example, using daily stock market index data for the US and Pacific-Basin countries (namely, Japan, Hong Kong, Singapore, Taiwan and Thailand) over a period from January 1984 to December 1991, Liu and Pan (1997) used a simple GARCH model to examine whether the US market had a greater influence than the Japanese market, on the four stock exchanges in the region. Their results suggested that the US stock market had a dominant influence on Asian equity returns. Ng (2000), Wang et al. (2005) and a recent study by Sok-Gee et al. (2010) arrived at a similar conclusion; they found that the US market had a significant impact on ASEAN-5 countries including Malaysia, the Philippines, Singapore, Thailand and Indonesia[79]. Liu and Pan (1997) reported that there were variations in the transmission of volatility among markets; for example, spillover increased after the 1987 Crash. Kanas (1998) documented similar effects on volatility transmission between markets after the 1987 US stock market crash for a sample of different countries including the UK, Germany and France.

Wang et al. (2005) used a univariate EGARCH model for analysing returns and volatility spillovers among (i) the two developed markets of the US and Japan; and (ii) three emerging markets of South Asia including India, Pakistan and Sri Lanka. Daily data were used for the five countries in the sample over the period from January 1993 to December 2003. The results of the study indicated that both the US and the Japanese markets had a significant impact on the returns and volatility in the three South Asian countries although the US had a greater impact than

[79] Ng (2000) studied Hong Kong, Korea, Malaysia, Singapore, Taiwan and Thailand and the US and Japanese markets.

Japan[80]. Return spillovers were found from both the US and Japan to all three South Asian stock markets whereas volatility spillovers were found from the US to India and Sri Lanka and from Japan to Pakistan. More spillovers, with greater intensity, were found after the 1997 Asian crisis which is consistent with the argument that integration among the markets increased during the crisis due to a contagion effect (Masih and Masih, 1999)[81]. Recently, Sok-Gee et al. (2010) analysed the volatility spillovers of the ASEAN-5 stock markets with the US and Japan. They used daily stock index data from March 1999 to December 2007 and an EGARCH model for the estimation of volatility spillovers among the markets. Their results indicated that the US market had a significant influence in all five countries in terms of both return and volatility spillovers. Volatility in Japan had a significant negative effect on two countries; namely, the Philippines and Singapore. In addition, they indicated that a country's returns were influenced by their own past returns and price changes in some other regional markets[82]. They further reported that intra-regional spillovers were found more frequently than inter-regional spillovers for a set of 12 emerging countries from various regions throught the world[83].

More recently, Mukherjee and Mishra (2010) examined stock market integration and volatility spillovers in 13 Asian countries[84]. Daily data were used over a period from July 1997 to April 2008 and a GARCH model was employed. They found strong bidirectional spillovers among India and most of the other Asian countries were found. In addition, returns in Hong Kong,

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[80] Fifield and Power (2006) found that stock markets in the Asian region were strongly influenced by global factors.
[81] The results were also in agreement with Lamba (2005) who found that the Indian market was influenced by the developed markets of the US, the UK and Japan whereas Pakistan and Sri Lanka were relatively isolated from these markets during the time frame of their study.
[82] One reason for the regional markets impact may be because of some close trade or financial linkages among the countries which affected each other during the period of examination.
[83] The countries included Malaysia, South Korea, Taiwan and Thailand from Asia, the Czech Republic, Hungary, Poland and Russia from Central and Eastern Europe, and Argentina, Brazil, Chile and Mexico from Latin America.
[84] The countries included China, Hong Kong, India, Indonesia, Japan, Korea, Malaysia, Pakistan, the Philippines, Singapore, Sri Lanka, Taiwan and Thailand.

Korea, Singapore and Thailand caused movements in India whereas Pakistan and Sri Lanka were strongly influenced by movements in the Indian market. One reason for this impact may have been the regional ties among the South Asian countries such as SAARC, SAFTA and SAFE[85]. Moreover, the Indian stock market was the largest in the region and its influence on other small stock markets of the region, especially Pakistan, Sri Lanka and Bangladesh, may have been more prominent. A summary of selected studies is given in Table 3.3.

From the literature review focusing on return and volatility spillovers, it is evident that most of the previous studies have concentrated on transmission amongst developed markets. In addition, some of these studies have emphasised the spillovers from developed markets to emerging markets. A large number of these studies have investigated spillovers by employing univariate or bivariate GARCH models. A serious limitation of the univariate volatility models is that they model the conditional variance of each series independently of all other series. According to Brooks (2008), this limitation is important for two main reasons. First, univariate models are deemed to be mis-specified for volatility spillovers where volatility changes in one market are followed by changes in volatility in another market. Second, in some instances, for example calculating hedge ratios and portfolio value-at-risk estimates, the covariances are of interest as well as the variances of the individual series. Multivariate GARCH models can be used to estimate volatility spillovers among various series. In addition, multivariate models estimate the conditional covariance as well as the conditional variances simultaneously; they are superior to their univariate counterparts.

[85] These regional agreements are discussed in Chapter 2.

Few studies have used multivariate GARCH models to investigate both return and volatility spillovers in own and cross markets[86]. Studies employing multivariate GARCH models are scarce in emerging markets in general and in the South Asian region in particular. One reason for the paucity of literature in this area is advanced by Li and Majerowska (2008) who argued that although the techniques were introduced earlier, most of the software applications do not have the routines to estimate these models. In the existing literature using multivariate GARCH models, the focus is on developed or other emerging markets. South Asian markets are largely ignored in these studies. One of the main objectives of the current thesis is to investigate return and volatility spillovers: (i) it focuses on return and volatility spillovers among the emerging stock markets of South Asia to examine linkages in the region; (ii) it uses the multivariate GARCH-BEKK model to investigate return and volatility spillovers in own and cross markets; and (iii) it investigates the integration among the markets from both a return and volatility perspective. To the best of the researcher's knowledge, no study has focused on the region using the multivariate GARCH-BEKK model.

[86] For more details about these studies, the reader is referred to Chapter 7.

**Table 3.3: Summary of Studies Showing Volatility Spillovers in Emerging Stock Markets**

| Author(s) | Countries | Time period | Sample | Method(s) | Key Findings |
|---|---|---|---|---|---|
| **Kanas (1998)** | France , Germany, and UK | Jan 1984 to Dec 1993 | Daily data | Univariate and bivariate EGARCH | Reciprocal volatility spillovers between London and Paris and between Paris and Frankfurt; unidirectional spillovers from London to Frankfurt. |
| **Wang, Gunasekarage and Power (2005)** | India, Japan, Pakistan, Sri Lanka and US | Jan 1993 to Dec 2003 | Daily data | Univariate EGARCH model | Return spillovers from the US and Japan to all three markets, and volatility spillovers from the US to Sri Lanka and India, and from Japan to Pakistan. More spillovers with greater intensity were found during the post 1997 Asian crisis period. |
| **Sok-Gee, Karim and Karim (2010)** | Indonesia, Japan, Malaysia, the Philippines, Singapore, Thailand and US | March 1999 to Dec 2007 | Daily data | EGARCH model | The US had a significant influence on both return and volatility spillovers in all ASEAN-5 countries, Japan had a significant negative impact on the Philippines and Singapore only. In most of the sample countries, own past returns influence current returns. |
| **Liu and Pan (1997)** | Hong Kong, Japan, Singapore, Taiwan, Thailand and US | Jan 1984 to Dec 1991 | Daily data | GARCH model | The US market had significant spillover effects on all four countries. More spillover effects were found after the 1987 stock market crash. The effects from Japan to these countries were of less importance. |
| **Mukherjee and Mishra (2010**) | China, Hong Kong, India, Indonesia, Japan, Korea, Malaysia, Pakistan, Singapore, Sri Lanka, the Philippines, Taiwan and Thailand | July 1997 to April 2008 | Daily data | GARCH model | There were strong contemporaneous spillovers from other markets to India. Dynamic intraday spillovers among India and its major counterparts were weaker. Hong Kong, Korea, Singapore and Thailand had a significant effect on the Indian market. The Indian market had a significant effect on Pakistan and Sri Lanka. |
| **Worthington and Higgs (2004)** | Hong Kong, Indonesia, Japan, Korea, Malaysia, Singapore, the Philippines, Taiwan and Thailand | Jan 1998 to Oct 2000 | Weekly data | Multivariate-GARCH model | Mean spillovers from developed to emerging markets were not homogeneous. Own past volatilities were more important than cross volatilities. |

Table 3.3 show summary of selected studies investigated volatility spillover in emerging markets. In particular, the table highlights the countries, the period of study, the methods used for investigation and the key findings of each study.

### 3.6: International Portfolio Diversification

The earliest research on international portfolio diversification dates back to Grubel (1968), Levy and Sarnat (1970), Lessard (1973), Solnik (1974) and Jorion (1985). All of these authors investigated the benefits of investing in equities from more than one country. For example, Grubel (1968) investigated monthly returns data for 11 countries over a period from January 1959 to 1966 and found that a US investor could have achieved a return of 12.6 per cent from international investment as against a return of only 7.5 per cent with the same level of risk (as measured by the standard deviation) from investment in their home country. Using a larger sample of countries for a longer time span, Levy and Sarnat (1970) reported benefits from international diversification by examining the return from an investment in a portfolio of equities from up to 28 countries over the period 1951 to 1967. An analysis of the mean and standard deviation of the annual returns data revealed that investing in nine developing countries from the sample generated a return of 5.0 per cent with a standard deviation of 26.5 per cent. Investing in all 28 countries resulted in a return of 12.0 per cent with a standard deviation of 8.0 per cent. They concluded that international portfolio diversification allowed portfolios to be constructed which had lower risk and higher returns.

Lessard (1973) argued that multinational portfolios outperformed single country investments even if the same proportion is invested in each country[87]. Solnik (1974) subsequently investigated the benefits from international diversification for US investors by analysing weekly share price data for eight countries over the period from 1966-1971. By comparing a US-only

[87] Lessard (1973) argued that, contrary to the assumption of more diversified investment, significant benefits are available by investing in a single geographical region. These results were based on an analysis of the four Latin American countries of Argentina, Brazil, Chile and Colombia for the period from December 1958 to December 1968.

portfolio with a selection of international equities, Solnik (1974) found that significant gains were available from investment in more than one country; in fact, the risk level was reduced from 27.0 to 11.7 per cent by holding the same number of international securities as was included in the domestic–only portfolio. Jorion (1985) used a different approach from previous studies in the area; he employed regression analysis and simulated three investment strategies[88]. Investigating seven countries over the period from 1971-1983, he found that most of the benefits from international diversification were due to risk reduction.

More recently, Bailey and Stulz (1990) used daily share returns data in US dollars for nine Pacific Basin countries and the US S&P 500 stock index from January 1977 to December 1995[89]. Correlations were measured for the Pacific Basin countries with the US market using (i) same day returns; (ii) the US returns lagged by one day; (iii) weekly returns; and (iv) monthly returns. Based on these measures of correlations, an *ex-post* efficient frontier was constructed. Their results indicated that using same day returns estimates, US investors could reduce risk (as measured by standard deviation) from 13.0 to 6.0 per cent without changing the mean returns available from diversifying into the Pacific Basin region[90]. Fletcher and Marshall (2005) arrived at a similar conclusion; they investigated the benefits from international portfolio diversification when a UK perspective was adopted. They used data for three asset classes from 17 developed countries over a period from January 1985 to December 2000 and found that significant gains

[88] Specifically, his simulation included a passive approach, a classical strategy and a Bayes-Stein approach. In the passive approach (used as a benchmark), investors could hold the US index, the world index or an equally-weighted index. In the classical strategy, investors chose efficient frontier portfolios based on mean per standard deviation which resulted in a ratio of 0.024. The Bayes-Stein approach shrunk past mean values to a common value and outperformed the classical strategy with a mean per standard deviation ratio of 0.203.
[89] The nine Pacific Basin countries included Australia, Hong Kong, Japan, Malaysia, the Philippines, Singapore, South Korea, Taiwan and Thailand.
[90] The results for the monthly returns measures were less dramatic with risk reduction from 13 to 9 per cent, which was still significant for US investors. The reason for the diminishing benefits was greater correlation in the markets over a longer time period.

were available from international portfolio diversification even allowing for short-sale constraints[91].

More recently, Driessen and Laeven (2007) used regression analysis on monthly stock index data from 52 countries (23 developed markets and 29 developing markets) over a period from 1985-2002[92]. They analysed the increase in the Sharpe ratio in order to quantify the economic magnitude of any benefits from diversifying internationally. They found that the average Sharpe ratio increased from 10.0 to 21.0 per cent when global diversification was allowed with no short-sales constraints. With the introduction of constraints limiting an investor's ability to sell securities short, the benefits were still significant with an average increase in the Sharpe ratio from 10.0 to 18.0 per cent. They concluded that investors from developing countries could benefit more than from developed countries by investing internationally[93].

All of these studies have demonstrated that significant benefits are available from international diversification[94]. In particular, the studies agree in their conclusion that when return correlations among the markets are low, diversification into these markets will result in a reduction of risk with the possibility of higher returns.

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[91] De Roon et al. (2001) argued that diversification benefits in emerging markets disappear when short-sale constraints or transaction costs are imposed. Fletcher and Marshall (2005) imposed short-sale constraints to investigate the benefits from international diversification, and found that gains were available from international portfolio diversification even after allowing for these constraints.

[92] They investigated the gains from international diversification from a local perspective as they argued that as the US is the most diversified and developed market, the US investor perspective might not represent investors in most other countries of the world.

[93] They argued that because of the greater country risk in developing countries, the benefits from global diversification were greater for investors from these countries.

[94] Lessard (1976) argued that systematic risk could not be diversified in domestic investment, whereas across national borders, systematic risk could be diversified away due to lower correlations. Hunter and Coggins (1990) reported that the extent of benefits from international diversification was determined by the level of correlations the national stock markets had with the world market. They further argued that although the benefits from international investment were not unlimited, the potential gains were significant.

The diversification potential of ESMs has attracted the attention of a growing number of researchers because of the low return correlations with equities from developed stock markets. For example, Levy and Sarnat (1970) and Errunza (1977) used data for both developed and developing countries while Lessard (1973) investigated the diversification potential of equities from Latin America. All of these studies reported benefits from combining ESM equities into a US-only portfolio. With the IFC classification of the countries' stock exchanges as ESMs and the increasing availability of data for countries outside of Europe, North America and Australia, studies in this area have increased.

Many researchers have investigated the potential benefits of investing in emerging markets securities. The common finding from these studies is that including emerging market equities in investment portfolios will enhance returns and reduce risk (Errunza, 1983; Speidell and Sappenfield, 1992; Wilcox, 1992; Hartmann and Khambata, 1993; Harvey, 1995; Bekaert and Urias, 1999; Fifield et al., 1999; Middleton et al., 2008; Chiou et al., 2009). One of the first studies to consider this issue was Lessard (1973). He looked at four ESMs in Latin America (Argentina, Brazil, Chile and Colombia) and reported large diversification gains from the region. Using quarterly returns data for the period 1975-1991, Speidell and Sappenfield (1992) estimated the standard deviation and expected returns of portfolios involving equities from 18 developed and 18 emerging markets. They concluded that because of the increased correlations among the developed markets, the benefits of diversification had declined for this group of countries; hence the inclusion of emerging market securities in a portfolio had grown in importance. Harvey (1995) investigated data for 20 emerging markets and the three developed markets of Japan, the UK and the US for the period from January 1976 to June 1992. He reported that the average return for the emerging markets composite index was 20.4 per cent with a standard deviation of 24.9 per cent, whereas the average return from the MSCI World composite index was 13.9 per cent with a standard deviation of 14.4 per cent. He further reported that average cross-country correlations of stock returns in Argentina, Colombia, India, Nigeria, Pakistan, Venezuela and Zimbabwe with the developed markets were zero. These relatively low correlations between emerging markets and developed markets suggested that diversification benefits might have been substantial for any investor who invested in these markets. Harvey (1995) argued that securities in emerging markets offered both high returns and lower risks. Bekaert and Urias (1999) suggested that even indirect investment in ESMs offered some potential diversification; there were significant benefits for both US and UK investors from investing in emerging market closed-end funds, open-end mutual funds and American Depository Receipts (ADR's) for the period from 1993-1996. In fact, the benefits for an earlier period (1990-1993) were higher for UK rather than US investors[95].

Li et al. (2003) investigated the effect of short-sale constraints on any diversification benefits in G7 countries as well as eight emerging markets over the period from January 1976 to December 1999[96]. They found that the benefits from diversification existed even after investments were restricted to long positions in the investable securities of these markets[97]. In a more recent study, Chiou et al. (2009) examined the benefits from international diversification from a US perspective. Monthly data were used over the period from January 1993 to December 2005 for the analysis of data from 21 developed and 23 emerging market countries. They reported that, under constraints such as no short-selling and over-weighting domestic securities, US investors could still achieve benefits from international diversification. They further reported that, although the world markets were becoming more integrated, there were still benefits from international diversification. Specifically, Chiou et al. (2009) reported that:

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[95] Errunza et al. (1999) also showed that diversification benefits could be obtained from investing in country funds and ADRs traded in the US. More recently, Fletcher and Marshall (2005) and Chiou et al. (2009) found that diversification benefits were still available for UK and US investors even after allowing for short-sale constraints.

[96] The G7 countries included Canada, France, Germany, Italy, Japan, the UK and the US, while the emerging markets studied were Argentina, Brazil, Chile, Mexico, Hong Kong, Singapore, South Korea and Thailand.

[97] Investable securities refer to stocks that are available for foreign investors and which meet minimum size and liquidity criteria.

> "The difference in cultural backgrounds, natural endowments, institutional systems and legal traditions deter integration of international financial markets so that investors may generate gains from overseas diversification". (p.451)

From this discussion, it is clear that emerging market portfolios have historically outperformed in terms of reducing risk and increasing returns for international investors. According to Standard and Poor's (2009), the top 25 performing stock markets (ranked by percentage change in price indices in US$), included 22 emerging markets with Ghana, Malawi, Namibia, Guyana, Fiji, Ecuador and Tunisia in the top seven places; these markets had percentage changes in their price indices of 58.1, 25.3, 19.9, 11.8, 8.9, 5.9, and 1.8, respectively.

Emerging markets in the South Asian region have shown negative or very low return correlations with other emerging and developed markets. It seems that investors can benefit by including securities from these markets in their portfolios. According to Hartmann and Khambata (1993), two of the region's markets (Pakistan and India) exhibited correlations of 0.06 and -0.03 with the S&P 500 index; Speidell and Sappenfield (1992) documented even lower correlations of -0.29 and -0.32 with the S&P 500 over an earlier time period. According to Fifield et al. (2002), Sri Lanka had the lowest correlation of its weekly returns with 11 other markets in their ESM sample[98]. In a recent study of 21 developed and 23 emerging markets, Chiou et al. (2009) showed that returns from South East Asian emerging markets have lower correlations with equity price changes from other countries than the developed markets. Specifically, India and Sri Lanka reported average correlations of 0.262 and 0.181, respectively, with all countries in the sample; these values were lower than those reported for most other emerging markets.

Using Vector Autoregression (VAR) and impulse response analysis some researchers, including Eun and Shim (1989), Cheung and Mak (1992), Park and Fatemi (1993), Chung and Liu (1994),

[98] The 11 countries included Chile, Hong Kong, Indonesia, Malaysia, Mexico, the Philippines, South Africa, Singapore, Taiwan, Thailand and the UK, where the correlations ranged from -0.058 for Sri Lanka- South Africa to -0.003 for Sri Lanka-Mexico.

Arshanapalli et al. (1995) and Janakiramanan and Lamba (1998), have examined the relationships among different stock markets. These studies have focused mainly on the short-run causal linkages among equity markets in order to understand how shocks in one market are transmitted to other markets. These studies have typically found that the US influenced most markets in the Asian region, while markets in this region have little influence on the US market. The UK market appears to exert some influence on markets in Japan, Australia and Hong Kong. Previous studies also found that Japan (the second largest equity market) had little influence on other equity markets. In addition, the linkages among Pacific-Basin equity markets were often attributed to the direct and indirect influences of the US market.

While previous researchers have examined the linkages among various emerging equity markets especially in Central and Eastern Europe, Latin America, Eastern Asia and the Pacific-Basin region, South Asian markets have received very little attention resulting in few studies that have examined the short- and long-run behaviour of these markets in greater detail. In addition, most of the previous studies investigating the South Asian markets have included only one or two of these markets as part of a broader sample. For example, Chan et al. (1997) included India and Pakistan from the South Asian region in their sample of 18 countries. The current thesis investigates linkages among the markets both in the short- and long-term and tries to fill the gap in the literature.

## 3.7: Conclusion

From the discussion in this chapter, a number of key findings emerge about the benefits from diversification across national borders and stock market efficiency, especially in the emerging markets of the world. Historical prices in own and other market have been found to predict share price changes in emerging markets. These findings have implications for the EMH and imply that investors in these markets may be able to reap above average returns based on historical data from own and other markets. However, the picture is not very clear for the South Asian emerging markets, and hence, the current thesis will fill this gap by investigating whether own and cross-market price changes can be used to predict share price changes in these markets. In addition, inside an economy, various industries and sectors produce goods and services. The growth in these industries is depicted in their share returns on the exchange. In many emerging markets, macroeconomic variables are closely related to share returns. An analysis of these variables may forecast share price changes and potential gains from investment in these countries stock markets.

Recently, the focus has shifted towards investigating linkages among the markets from both a return and volatility perspective. The transmission mechanisms among the stock markets have implications for stock market efficiency and portfolio management. The presence of return linkages among the stock markets implies the existence of potentially exploitable trading strategies. If these strategies results in earning profits after the deduction of transaction costs, this represents evidence against market efficiency. From the perspective of international diversification, strong market linkages eliminate the potential benefits from investing into emerging markets. Volatility analysis is particularly important because it can be used as a proxy for the risk of the securities in a portfolio.

Investing in emerging markets may enhance in the portfolio performance in terms of both risk reduction and increasing returns. These benefits are due to differences in the economic activities of various countries, varied economic structures, and differences in legal systems and institutional setups. These differences result in the segmentation of developing countries from their developed counterparts of the world. In recent years, although global markets have become increasingly integrated with each other, international investors may still be able to increase return and reduce risk by investing in emerging markets.

# Chapter 4

# Research Methodology and Methods

## 4.1: Introduction

This chapter outlines the methodology and methods used in this research. In particular, the chapter describes the varying ontological and epistemological assumptions made by researchers when undertaking research in the social sciences. The chapter also provides an overview of the different methodologies that are employed by researchers in the social science area including accounting and finance. More specifically, Section 4.2 outlines the philosophical assumptions that underpin the current research with regard to ontology, epistemology, human nature and methodology. The nature of society and its related assumptions (the sociology of radical change and sociology of regulation) is also described. In addition, the research paradigms are discussed and the reasons for the selection of a particular paradigm are highlighted. Section 4.3 outlines the research assumptions of the current thesis and the justifications for these assumptions are supported with reference to the underpinnings which inform most of the research in the field of accounting and finance.

After discussing the methodological issues associated with the analysis, the research methods employed in this thesis are outlined in Section 4.4. A quantitative approach is employed since this helps address the research questions of the thesis and emerges from the functionalist paradigm in which the thesis is located; statistical and econometric methods are used for the current investigation. The research methods include the Johansen multivariate cointegration technique, the Vector Error Correction Model (VECM), a generalised impulse response function analysis and a variance decomposition analysis; these techniques are used to investigate the linkages among the South Asian emerging stock markets examined in this thesis. Both PCA and multivariate regression methods are used to investigate the relationships between equity prices and local, as well as global, macroeconomic variables. To investigate the linkages among the stock markets in greater depth, the multivariate Generalised Autoregressive Conditional Heteroscedasticity model of Baba, Engle, Kraft and Kroner (GARCH-BEKK) is used to examine return and volatility spillovers among the stock markets of Bangladesh, India, Pakistan and Sri Lanka. The final section (Section 4.5) summarises the main conclusions of this chapter.

### 4.2: Philosophical Assumptions Underpinning Social Science Research

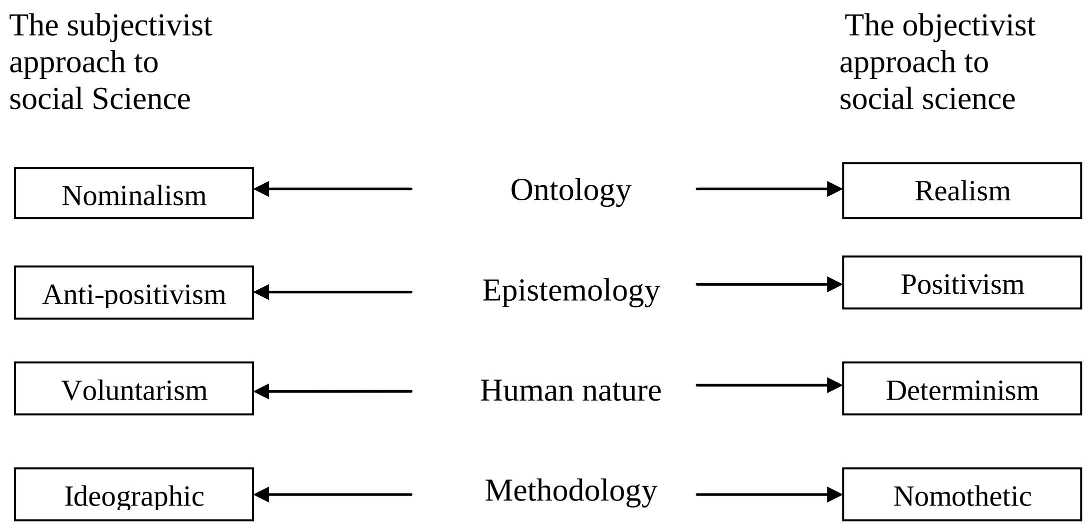
In social science research, a number of philosophical assumptions affect the research work undertaken. These assumptions emerge from the researcher's perception about the world. In terms of the philosophical assumptions about the nature of social science, Burrell and Morgan (1979) proposed a subjective – objective framework. This framework comprises four distinct categories of philosophical assumptions about the nature of social science, namely, ontology, epistemology, human nature and methodology. Burrell and Morgan (1979) argued that various approaches to social science research depend upon assumptions relating to these four factors. In particular, they argued that sociological positivism and German idealism define the objective and subjective aspects of the framework, respectively. The objectivist approach to social science research assumes that entities exist in a real world, external to those individuals involved in the research process (Saunders et al., 2007). Similarly, according to Bryman (2004), the objectivist approach assumes that the social world exists independently of, and is separate from, human beings. By contrast, the subjectivist approach views entities as social constructs, where their 'existence' depends upon the perceptions and actions of human beings in the social world (Bryman, 2004).

Figure 4.1 outlines the two extremes of the subjective – objective framework with the related assumptions about the nature of social science proposed by Burrell and Morgan (1979). The first assumption of this framework concerns ontology. According to Saunders et al. (2007), ontology deals with the nature of being and explains assumptions about reality. Burrell and Morgan (1979) argued that reality may exist in the world external to the individual or it may be the product of individual internal consciousness; it may be 'objective' in nature, existing independently from human beings, or it may be constructed in individuals' minds. The ontological debate revolves around two approaches, namely 'nominalism' and 'realism'. The former approach to reality suggests that the social world exists in our perceptions and is made up of names, labels and concepts; there is no 'real' structure to the world which these concepts describe:

> "The 'names' used are regarded as artificial creations whose utility is based upon their convenience as tools for describing, making sense of and negotiating the external world" (Burrell and Morgan, 1979, p.4).

**Figure 4.1: Assumptions about the Nature of Social Science Research**

**The Subjective - Objective Dimension**




Source: Burrell and Morgan (1979, p.3)

By contrast, the latter approach to 'reality' postulates that the social world exists independently of human perception and is made of real, concrete structures:

> "The social world exists independently of an individual's perception of it. The individual is seen as being born into and living within a social world which has a reality of its own. It is not something which the individual creates- it exists 'out there'; ontologically it is prior to the existence and consciousness of any single human being" (Burrell and Morgan, 1979, p.4).

The second assumption of the subjective – objective framework relates to epistemology. This assumption is concerned about “how one might begin to understand the world and communicate this as knowledge to fellow human beings” (Burrell and Morgan, 1979, p.1). Epistemology seeks to explain “whether knowledge is something which can be acquired”, termed as ‘positivism’ on the subjective – objective dimension, or is “something which has to be personally experienced”, termed as ‘anti–positivism’ (Burrell and Morgan, 1979, p.2). Positivism is based on hard facts and is often linked to quantitative research. According to Saunders et al. (2007), it involves models and methods of research from the natural sciences which are appropriated by social scientists for the study of human nature. A positivist epistemology “seeks to explain and predict what happens in the social world by searching for regularities and causal relationships between its constituents elements” (Burrell and Morgan, 1979, p.5). By contrast, an anti–positivist epistemology assumes that:

> “the social world is essentially relativistic and can only be understood from the point of view of the individuals who are directly involved in the activities which are to be studied” (Burrell and Morgan, 1979, p.5).

Anti–positivists view knowledge about the social world as being subjective rather than objective (Burrell and Morgan, 1979).

The third assumption of the subjective – objective framework relates to the researcher’s view about human nature in social sciences; it is associated with ontological and epistemological assumptions but is conceptually separate. This assumption explains the relationship between human beings and their environment (Burrell and Morgan, 1979). It takes two extreme perspectives of human nature: namely, ‘determinism’ and ‘voluntarism’. The former believes that human beings are controlled by the environment, whereas the latter assumes that human beings can influence the environment in which they exist. According to Burrell and Morgan (1979, p.6):

> "a deterministic view regards man and his activities as being completely determined by the situation or 'environment' in which he is located", by contrast, "the voluntarist view [argues that] man is completely autonomous and free-willed".

The fourth assumption of the subjective – objective continuum relates to methodology. The assumptions about ontology, epistemology and human nature directly influence the choice of an appropriate methodology. Burrell and Morgan (1979, p.2) stated that "Different ontologies, epistemologies and models of human nature are likely to incline social scientists towards different methodologies". Ryan et al. (2002) argued that it is important to distinguish between methodology and methods. Based on assumptions about ontology, epistemology and human nature, methodology refers to the "process of doing research"; by contrast, methods are the "techniques used in research" (Ryan et al., 2002, p.36). Along Burrell and Morgan's subjective – objective dimension, methodology may be categorised as 'ideographic' or 'nomothetic'. An ideographic methodology should be used when reality is based on subjective experiences and humans have free will (Ryan et al., 2002). The ideographic approach is based on "obtaining first-hand knowledge of the subject under investigation" (Burrell and Morgan, 1979, p.6). By contrast, if the researcher assumes that reality is not socially constructed and believes in the deterministic view of human nature, nomothetic methods of research should be used. This approach focuses on "quantitative techniques for the analysis of data" (Burrell and Morgan, 1979, p.7)[99].

Burrell and Morgan (1979) also highlighted the different assumptions that are made by social science researchers regarding the nature of society which is being investigated. The two dimensions of 'order' and 'conflict' from the earlier work of Dahrendorf (1959) were replaced by Burrell and Morgan (1979) with the 'sociology of regulation' and the 'sociology of radical change', respectively. To overcome some of the limitations of the 'order-conflict' assumptions

[99] Godfrey et al. (2000) argued that quantitative techniques, as used in the natural sciences, focus on hypothesis testing in order to draw conclusions from the research.

about the nature of society, Burrell and Morgan (1979) introduced the dimensions of 'regulation' and 'radical change' to clarify the distinction between the research interests of those investigating social science[100]. Table 4.1 shows the regulation – radical change dimension introduced by Burrell and Morgan (1979).

**Table 4.1: The Regulation – Radical Change Dimension**

| **The sociology of Regulation is concerned with:** | **The sociology of Radical Change is concerned with:** |
|---|---|
| (a) The status quo | (a) Radical change |
| (b) Social order | (b) Structural conflict |
| (c) Consensus | (c) Modes of domination |
| (d) Social integration and cohesion | (d) Contradiction |
| (e) Solidarity | (e) Emancipation |
| (f) Need satisfaction | (f) Deprivation |
| (g) Actuality | (g) Potentiality |

Source: Burrell and Morgan (1979, p.18)

The sociology of regulation is adopted by researchers who wish to understand the elements of social science that regulate human activities and maintain social order. Burrell and Morgan (1979) stated that the sociology of regulation focuses mainly on "the need for regulation in human affairs" (p.17). They suggested that "the basic questions which it asks tend to focus upon the need to understand why society is maintained as an entity. It attempts to explain why society tends to hold together rather than fall apart"(p.17). By contrast, the 'sociology of radical change' is adopted by researchers who assume that individuals should be free from societal structures. They reject the status quo and seek fundamental changes in the social order. Burrell and Morgan (1979) stated that the sociology of radical change concentrates on "man's emancipation from the structures which limit and stunt his potential for development" (p.17).

[100] Burrell and Morgan (1979) replaced the 'order-conflict' continuum with the 'sociology of regulation' and 'sociology of radical change' due to its oversimplification and their openness to various interpretations.

**Figure 4.2: Four Paradigms for the Analysis of Social Theory**

**THE SOCIOLOGY OF RADICAL CHANGE**

| | | | |
|---|---|---|---|
| | **Radical Humanist** | **Radical Structuralist** | |
| **SUBJECTIVE** | | | **OBJECTIVE** |
| | **Interpretive** | **Functionalist** | |

**THE SOCIOLOGY OF REGULATION**

Source: Burrell and Morgan (1979, p.22).

Combining these two dimensions (the subjective – objective dimension of social science and the regulation – radical change dimension of society), Burrell and Morgan (1979) proposed four paradigms for social science research - the functionalist, interpretive, radical humanist and radical structuralist paradigms[101,102]. The four paradigms "provide a tool for establishing where you are, where you have been and where it is possible to go in the future" (Burrell and Morgan, 1979, p.24).

The functionalist paradigm is located in the bottom – right hand quadrant of Figure 4.2. This paradigm combines the sociology of regulation perspective of society with an objective view of social science. The functionalist approach adopts methods from the natural sciences to the study of social science (Burrell and Morgan, 1979). According to Burrell and Morgan (1979), the

[101] Bryman (2008) defined a paradigm as "A term deriving from the history of science, where it was used to describe a cluster of beliefs and dictates that for scientists in a particular discipline influence what should be studied, how research should be done, and how results should be interpreted" (p.696).
[102] Kuhn (1970) described a paradigm as a cluster of beliefs which guide researchers to decide what should be studied and how results should be interpreted.

functionalist paradigm assumes that the social world is “composed of relatively concrete empirical artefacts and relationships which can be identified, studied and measured through approaches derived from natural sciences” (p.26). The functionalist paradigm is thus based on a realist ontology, a positivist epistemology, a deterministic view of human nature and a nomothetic methodology. The sociology of regulation perspective of society is adopted; hence, the functionalist paradigm seeks to explain the status quo, social order, consensus, social integration, solidarity, need satisfaction and actuality (Burrell and Morgan, 1979).

The interpretive paradigm shares an assumption about the sociology of regulation with the functionalist paradigm on one side; on the other side, it shares the subjective dimension of assumptions about social science research with the radical humanist paradigm. From the sociology of regulation perspective, the interpretive paradigm is concerned with providing explanations of the status quo, social order, consensus, social integration, solidarity, need satisfaction and actuality as in the functionalist paradigm. It differs from the functionalist paradigm as it focuses on the research issue from a subjective point of view with a nominalist ontology, anti-positivist epistemology, voluntarist view of human nature and ideographic methodology. Burrell and Morgan (1979) argued that the interpretive paradigm is concerned with the understanding of the world as it is, without necessarily wanting to changing it.

The radical humanist paradigm in the top-left hand quadrant of Figure 4.2 is based upon a subjective assumption about social science research and the need for sociological change. This paradigm shares the subjectivist view of social science with the interpretive paradigm. It views the social world from the perspective of a nominalist ontology, an anti-positivist epistemology, a voluntarist view of human nature and an ideographic methodology. The paradigm is concerned with the radical change end of the regulation continuum; with these assumptions about society, the radical humanist paradigm focuses on changing the status quo, modes of domination, emancipation, deprivation and the potentiality of individuals. The radical humanist paradigm is completely different from the functionalist paradigm as it has different assumptions about the nature of social science and society.

The radical structuralist paradigm is located in the top-right quadrant of Figure 4.2. This paradigm combines assumptions about the sociology of radical change and an objective view of the social world. It is similar to the functionalist paradigm in the sense that they both adopt the same assumptions about reality but differ in their desire to change society. It is similar to the radical humanist paradigm in that it promotes the aim of radical change (Burrell and Morgan, 1979) but does so with an objective notion of reality; it is underpinned by a realist ontology, a positivist epistemology, a deterministic view of human nature and a nomothetic methodology. The radical structuralist paradigm differs completely from the interpretive paradigm as none of the two categories of assumptions about social science and society are similar.

According to Burrell and Morgan (1979), the four paradigms focus on the "alternative views of social reality". They argued that "to understand the nature of all four is to understand four different views of society". More importantly, they suggested that "one cannot operate in more than one paradigm at any given point in time" (p.25). Thus, they argued that the four paradigms are separate and mutually exclusive based on their different assumptions about the nature of society and social science. By contrast, Chua (1986) categorised the four paradigms into three groups. Combining the radical humanist and radical structuralist views of the world, she labelled the resulting paradigms as critical research; the functionalist paradigm was called mainstream research and the interpretive paradigm was termed "interpretive accounting" in Chua's typology of research.

Burrell and Morgan's (1979) framework has provided a methodological schema for social science research. This schema has been employed by numerous researchers who have sought to categorise different approaches to research within the accounting and finance areas (Chua, 1986;

Laughlin, 1995; Ryan et al., 2002; Bryman, 2004, 2008; Saunders et al., 2007). However, Burrell and Morgan's (1979) four paradigms have also been criticised because of the constraints which they impose on the researcher. For example, Burrell and Morgan (1979) stated that:

> "one cannot operate in more than one paradigm at any given point in time, since in accepting the assumptions of one, we defy the assumptions of all the others" (p.25).

Thus, Chua (1986) criticised Burrell and Morgan's four paradigms and labelled these as "unsatisfactory dichotomies" (p.626). She argued that researchers can adopt more than one paradigm at a time. She proposed a framework using three sets of beliefs: beliefs about knowledge, beliefs about the physical and social reality and beliefs about the relationship between theory and practice[103]. Chua (1986) argued that her framework could be applied to assess the strengths and weaknesses of different aspects of accounting as compared to the non-evaluative framework of Burrell and Morgan (1979). Chua's (1986) approach has some merit since it allows the researcher to adopt a mixture of paradigms at any one point in time; despite this criticism, the Burrell and Morgan framework tends to be seen as the key basis for outlining the philosophical assumptions to social science research and is more widely used (Middleton, 2006). In the current thesis, the researcher uses the functionalist paradigm without seeking to mix this approach with other paradigms. Thus, the Burrell and Morgan (1979) typology was useful for forcing this researcher to think about his own world view and to satisfy himself that the assumptions underpinning his research were valid. Further, it concentrated the researcher's attention on the questions being asked within the thesis and the appropriateness of the methodology as well as the methods being used. The next section expands on this issue by illustrating how the current research fits within Burrell and Morgan's functionalist paradigm.

[103] Chua (1986) merged the two paradigms of radical humanist and radical structuralist and called it critical research. In addition, functionalist and interpretive paradigms were called mainstream and interpretive accounting, respectively.

### 4.3: Research Assumptions Underpinning the Current Thesis

The objective of the current thesis is to explore the performance of, and linkages between, four South Asian stock markets without seeking to change the status quo. Thus, the radical humanist and radical structuralist paradigms are rejected as they assume that the goal of the researcher is to alter society in some fundamental way. The researcher accepts the assumptions of the functionalist and interpretive paradigms as Johnson and Duberley (2000) reported that "by accepting the assumptions that underpin the sociology of regulation, the assumptions that constitute the sociology of radical change are denied" (p.79). In particular, the thesis employed quantitative research methods based on share price data where the results are assumed to be generalisable for other similar markets; thus, this thesis was judged to emerge from the functionalist paradigm[104]. Furthermore, given the objective of the current thesis, the researcher believes that shares price changes in the South Asian emerging stock markets represent an important reality rather than human perceptions of socially constructed events. The share price changes are deemed to be important because they represent changes to individuals' wealth and have sizeable consequences for the economies of the region; for example, company investment plans may depend on the current level of the share price if capital spending is to be funded by an equity issue. Further, since the economies of these countries have liberalised, and foreign investors have been encouraged to own shares, the impact of share price changes is not restricted to nationals but can have global consequences[105]. Consequently, the current thesis adopts a realist ontology.

With respect to epistemological assumptions, the present thesis assumes a positivist view of what constitutes knowledge. This thesis seeks to investigate the causal relationships between equity

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[104] According to Bryman (2008), "Quantitative research usually emphasizes quantification in the collection and analysis of data. As a research strategy, it is deductive and objectivist and incorporates a natural science model of the research process (in particular, one influenced by positivism)" (p.697).

[105] The reader is referred to Chapter 2 for a discussion of the liberalisation measures that have been adopted in the South Asian stock markets examined in this thesis.

returns and predict shares prices by using historical data composed of real data. According to Burrell and Morgan (1979), positivist epistemologies "seek to explain and predict what happens in the social world by searching for regularities and causal relationships between its constituent elements" (p.5). Thus, share prices are assumed to constitute knowledge among market participants and are worthy of study by the researcher.

The present study assumes an intermediate position in between the two extreme assumptions ('determinism' and 'voluntarism') about human nature. On one hand, the stock markets in the South Asian region are assumed to be affected and controlled by their external environment; regulations of the relevant Securities and Exchange Commission and other regulatory bodies, the regional policies of SAARC and SAFE, and the political and socio-economic factors in these countries are all assumed to influence equity values. Based on these factors, a deterministic view of human nature is suitable. On the other hand, the stock markets in the region control their own decisions to some extent. The internal managements of the exchanges can freely decide on structures and procedures, subject to operating within the law. This implies that a voluntarist view of human nature is appropriate. Consequently, the present study adopts the intermediate position on the determinism – voluntarism continuum. This stance about human nature is recommended by Burrell and Morgan (1979) who stated that social science researchers may "adopt an intermediate standpoint which allows for the influence of both situational and voluntary factors in accounting for the activities of human beings" (p.6).

After reviewing the researcher's assumptions about ontology, epistemology and human nature, the methodological choices became relatively clear. The current study adopts a nomothetic methodology in order to conduct the research. This methodology is drawn from work in the natural sciences. The current thesis adopts quantitative techniques for analysis and assumes that the findings can be generalised – as is the case with results from the natural sciences. Sophisticated statistical and econometric techniques are used to investigate linkages among the stock markets and to study inter-relationships with both local and global macroeconomic variables. By selecting research questions which use concrete "facts" and make predictions about shares prices, the nomothetic methodology was deemed to be the most suitable for the current thesis.

The present study locates itself within the functionalist paradigm. The study adopts the assumptions of realist ontology, positivist epistemology, an intermediate view between the deterministic – voluntaristic model of human nature and a nomothetic methodology. The thesis investigates the weak form of the EMH for four South Asian emerging stock markets. In particular, the research examines the linkages among the stock markets in the region and looks for predictability in share prices from among these inter-relationships. In addition, local and global macroeconomic variables are examined to investigate whether share prices can be forecasted from historic data. The investigation of the share prices in these markets is assumed to be an objective phenomenon and the results provide information for all investors rather than a subjective assessment which is unique to some investors.

### 4.4: Research Methods

After determining the appropriate research paradigm from those proposed by Burrell and Morgan (1979), research methods were then selected to address the research questions. In particular, the statistical and econometric methods employed to investigate the weak form of the EMH in the South Asian emerging stock markets are described in the current section[106]. In Section 4.4.1, the research methods employed when examining the dynamic linkages among the four South Asian emerging stock markets of Bangladesh, India, Pakistan and Sri Lanka are discussed. To

[106] According to Chan et al. (1997), the implications from the error correction model is that share price changes in one market are predictable from those in another market if stock prices are cointegrated. On the other hand, if equity prices from two countries are not cointegrated then all available information has already been incorporated and the markets are efficient.

investigate these possible linkages a number of different methods were employed, including unit root tests, Johansen multivariate cointegration tests, VECM analysis and Granger Causality tests. In addition, the generalised impulse response function for each equity index was studied and a variance decomposition analysis performed. Section 4.4.2 describes the PCA and multivariate regression analysis methods used to investigate the relationships between (i) the stock markets and (ii) local as well as global macroeconomic variables. Section 4.4.3 then discusses the multivariate GARCH-BEKK model which was employed to examine return and volatility spillovers among the stock markets and to investigate the interdependences among the markets in greater detail.

### *4.4.1: Cointegration Analysis*

#### *4.4.1.1: Stationarity Tests*

Using Ordinary Least Square (OLS) estimates for non-stationary data results in a 'spurious regression'. In the case of stationary independent variables, the regression results would give an insignificant t-statistic for the slope coefficient and a low $R^2$ value. In the case where variables are non-stationary (trending over time), the regression results would seem to yield a good fit under standard measures of significance although the variables might be unrelated. Cointegration analysis is therefore used to investigate the long-run relationship among the four stock markets using non-stationary data.

Before cointegration is examined, empirical evidence about the relationships between the four markets in the South Asian region begins with a test of each series for a unit root in levels. To determine whether the level series of the price indices are non-stationary, which is a pre-condition for cointegration, and to find out if all series are integrated of the same order, the

Augmented Dicky-Fuller (ADF) (1979) and the Phillips-Perron (P-P) (1988) tests are used[107]. The difference between the two unit root tests (the ADF and the P-P) lies in the treatment of any 'nuisance' serial correlations (Chen et al., 2002). Following the procedure adopted by Gilmore and McManus (2002), the least restrictive models which include both a constant and trend term are used. The Augmented Dicky-Fuller (ADF)[108] test was performed using equation (4.1)[109].

$$\Delta X_t = \beta_1 + \beta_2 t + \delta X_{t-1} + \sum_{i=1}^{k} \psi \Delta X_{t-1} + \varepsilon_t \tag{4.1}$$

Where $\Delta$ is the first difference operator, $\beta_1$ is an intercept, $\beta_2 t$ is a linear trend, $i$ is the number of lagged first-differenced terms and $\varepsilon_t$ is a white noise error term[110]. One issue to be resolved before undertaking the ADF test is to determine the unknown number of the lagged first differences of the dependent variable required to capture auto-correlated omitted variables that would otherwise by default enter the error term. In other words, the ADF tests are only valid under the assumption of an i.i.d. process (Brooks, 2008). In practice, it is more likely to allow for some correlations among the error term $\varepsilon_t$. The P-P test is less restrictive in its assumptions about the data being i.i.d; it does not require the error terms to be serially uncorrelated and can operate when heteroscedasticity is present. Thus, the P-P test of the following form was also estimated:

$$\Delta X_t = \beta_1 + \beta_2 t + \delta X_{t-1} + \varepsilon_t \tag{4.2}$$

[107] Al-Khazali et al. (2006) argued that it is prudent to use more than one testing procedure to increase confidence in the robustness of the test results.

[108] The null hypothesis is $\delta = 0$. If $\delta$ is significantly different from zero, the hypothesis that $X_t$ contains a unit root is rejected. If the test on the level series fails to reject the null, the ADF procedure is then applied to the first difference. Rejection of the null hypothesis on the first difference will suggest that the series is integrated of order one, I(1).

[109] This equation is the general form of ADF having unit root with both constant and trend terms. It shows one of the three possible equations with (i) unit root with constant only; (ii) unit root with both constant and trend terms; and (iii) unit root with none of the constant and trend terms.

[110] White noise refers to the process having a constant mean and variance and zero auto-covariance at all lags.

The null hypothesis in these tests is that a series is non-stationary; the rejection of the null is therefore necessary to support the conclusion of stationarity. The critical values for the tests are based on MacKinnon (1996).

#### *4.4.1.2: Johansen Multivariate Cointegration Test*

The concept of cointegration was first introduced by Granger in 1981. However, Granger (1981) only outlined the characteristics of integrated series and did not propose procedures for testing cointegration. Later, Engle and Granger suggested a procedure for testing the hypotheses of cointegration (Engle and Granger, 1987). They proposed a simple two-step procedure for testing cointegration using the Ordinary Least Square (OLS) method. In the first step, a regression is estimated for two variables (in levels) and residuals are extracted. In the second step, the residuals from the first step are tested for a unit root. If the residuals are stationary (I(0)), the null hypothesis of no cointegration between the two series can be rejected. Engle and Granger's two-step procedure has been criticised for several reasons. First, several academics noted that because it involves a two-step process, any error introduced in the estimation of the error term will enter the subsequent error correction model (Brooks, 2008). Second, a number of commentators have highlighted that simply changing the two variables from the right-hand side to the left-hand side of the regression equation might give different results (e.g. Chen et al., 2002).

These problems with the Engle and Granger two-step procedure were overcome by Johansen (1988) and Johansen and Juselius (1990). They estimated the cointegrating vector using the maximum likelihood estimation technique. They provided a method of estimating a multivariate vector error correction mechanism (VECM) based on a vector autoregressive VAR (k) model with Guassian errors and its implications on equilibrium. Their process has the advantage of capturing both long- and short-term dynamic relationships of a system based on the series being examined.

Let $X_t$ be a vector of *n* stock market indices which are individually non-stationary and are integrated of the same order e.g. I(1). A VAR (k) model can be written as:

$$X_t = \mu + A_1X_{t-1} + A_2X_{t-2} + A_3X_{t-3} + \ \dots\dots + A_kX_{t-k} + \varepsilon_t \tag{4.3}$$

Where $X_t$ is a $4\times1$ vector of I(1) stock index series, $A_k$ is a $4\times4$ coefficient matrix, $t$=1,2,3,....T and $\varepsilon_t$ is a vector of white noise error terms. The VAR (k) model in (4.3) can be written as a VECM which takes the form:

$$\Delta X_t = \mu + \Gamma_1\Delta X_{t-1} + \Gamma_2\Delta X_{t-2} + \Gamma_3\Delta X_{t-3} + \ \dots\dots + \Gamma_{k-1}\Delta X_{t-k} + \Pi X_{t-k} + \varepsilon_t \tag{4.4}$$

Where $\Delta$ is a first difference operator, $\Gamma$ is a $4\times4$ coefficient matrix representing the short-term dynamics and is defined as:

$$\Gamma_m = -I + \sum_{i=1}^{m} A_i \qquad\qquad m = 1,2,3, \dots\dots\dots . k-1 \tag{4.5}$$

And $\Pi$ is a $4\times4$ matrix of coefficients representing long-term dynamics and is defined as:

$$\Pi = -I + \sum_{i=1}^{k} A_i \tag{4.6}$$

$\Pi$ is the long-term coefficient matrix and its rank $r$ determines the number of cointegrating vectors. If $\Pi$ has a rank $r$ then there are $r$ cointegrating relationships between the $X_t$ or $n-r$ common stochastic trends[111]. The number of cointegrating vectors shows the extent to which the stock markets in this study are integrated. If $\Pi$ has full rank ($n-r=0$ $or$ $n=r$) there are no stochastic trends and all elements of the $X_t$ vector are stationary or I(0), and no cointegration is

[111] *n* represents the number of variables. In this case it is four.

identified. If $\Pi$ has a rank of zero there are no stationary long-term equilibrium relationships among the elements of $X_t$. When $\Pi$ has a reduced rank such that $(0 < r < n)$, there exists $r$ cointegrating vectors, therefore, $n - r$ common stochastic trends. In this latter case, $\Pi$ can be factorised into $\alpha\beta'$, where both $\alpha$ and $\beta$ are $n \times r$ matrices. The $\beta$ matrix gives the cointegrating vectors whereas $\alpha$ is the adjustment matrix giving the amount of each cointegrating vector entering each of the equations for the VECM.

Johansen (1988, 1991) suggested two methods for estimating the number of cointegrating vectors; the trace test and the maximum eigenvalues ($\lambda_{max}$) test which are formulated as follows:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} In\left(1 - \hat{\lambda}_i\right) \tag{4.7}$$

and

$$\lambda_{max}(r, r+1) = -T In\left(1 - \hat{\lambda}_{r+1}\right) \tag{4.8}$$

$r$ is the number of cointegrating vectors and $\lambda_i$ is the estimated value for the $ith$ order eigenvalues from the $\Pi$ matrix. Intuitively, the larger the value of $\lambda_i$, the larger and more negative will be $(In(1 - \hat{\lambda}_i))$ and hence the higher the magnitude of the test statistic. Each eigenvalue will be associated with a different cointegrating relationship, which will be given by the associated eigenvector. A significant non-zero eigenvalue indicates a significant cointegrating vector. The $\lambda_{trace}$ statistic is a joint test of the null hypothesis that the number of cointegrating vectors is less than or equal to $r$ against a general or unspecified alternative hypothesis of more than $r$. The $\lambda_{max}$statistic conducts a separate test on each eigenvalue. The null hypothesis in this case is that the number of cointegrating vectors is $r$ against an alternative that there are $r + 1$ relationships.

Both the $\lambda_{trace}$ and $\lambda_{max}$ test statistics have non-standard distributions and their critical values depend on the values of $n-r$, the number of non-stationary components and whether constants and trends are included in each of the equations (Brooks, 2008)[112]. For both of these tests, the critical values are provided by Johansen and Juselius (1990), Osterwald-Lenum (1992), Doornik (1998) and MacKinnon-Haugh-Michelis (1999). In this thesis, the critical values are based on those proposed by MacKinnon-Haugh-Michelis (1999). If the test statistic is greater than the critical values, the null hypothesis of $r$ cointegrating vectors will be rejected in favour of the alternative hypothesis that there are $r+1$ ($\lambda_{trace}$ test) or more than $r$ (for $\lambda_{max}$ test) relationships among the equity indices. The testing is conducted in a sequence under the null of $r = 0,1 \ldots \ldots \ldots n-1$ so that the hypothesis for the $\lambda_{max}$ tests are:

$$H_0: r = 0 \quad versus \quad H_1: 0 < r \leq n \tag{4.9}$$

$$H_0: r = 1 \quad versus \quad H_1: 1 < r \leq n \tag{4.10}$$

$$H_0: r = 2 \quad versus \quad H_1: 2 < r \leq n \tag{4.11}$$

$$H_0: r = 3 \quad versus \quad H_1: 3 < r \leq n \tag{4.12}$$

.

$$H_0: r = n-1 \quad versus \quad H_1: r = n \tag{4.13}$$

The main advantage of Johansen's VAR estimation procedure is that multiple long-run equilibrium relationships can be estimated. Thus, such a procedure is appropriate to this research in which four South Asian stock markets are considered and allows discussions of degree of integration.

[112] These constant and trend terms can be either included in the cointegrating vectors or in the VAR as an additional term.

Johansen's multivariate cointegration analysis was applied in this thesis to investigate the interdependence among four South Asian markets. If the four stock markets share a common trend, then the gains from diversifying into this region may be reduced depending on how many stochastic trends there are. In addition, the existence of a cointegrating vector would suggest that the markets are not weak-form efficient since the VECM would indicate that returns in one market can be used to predict price changes in another (MacDonald and Power, 1994). The study investigates how the four markets are integrated with each other over various time periods and has implications for investors investing in this region.

#### *4.4.1.3: The Granger Causality Test*

A variable *X* might 'Granger cause' variable *Y* if past values of variable *X* explain variable *Y*. Similarly, variable *Y* 'Granger causes' variable *X*, if past values of *Y* explain *X* (Granger, 1969). The Granger causality test assumes that the information relevant to the prediction of the respective variables is contained solely in the time series data on these variables. The test involves estimating a pair of regression equations.

If the variables are not cointegrated, the following bivariate VAR equations in first differences are tested:

$$\Delta X_t = \sum_{i=1}^{n} a_i \, \Delta Y_{t-i} + \sum_{j=1}^{n} \beta_j \, \Delta X_{t-j} + \mu_{1t} \qquad (4.14)$$

$$\Delta Y_t = \sum_{i=1}^{n} \lambda_i \, \Delta X_{t-i} + \sum_{j=1}^{n} \delta_j \, \Delta Y_{t-j} + \mu_{2t} \qquad (4.15)$$

On the other hand, if the variables are cointegrated, the following VECMs are tested:

$$\Delta X_t = \sum_{i=1}^{n} a_i \, \Delta Y_{t-i} + \sum_{j=1}^{n} \beta_j \, \Delta X_{t-j} + \phi e_{1t-1} + v_t \qquad (4.16)$$

$$\Delta Y_t = \sum_{i=1}^{n} \lambda_i \, \Delta X_{t-i} + \sum_{j=1}^{n} \delta_j \, \Delta Y_{t-j} + \phi e_{2t-1} + v_t \qquad (4.17)$$

Where $\mu_{1t}$ and $\mu_{2t}$ are uncorrelated disturbance terms, whereas $e_{1t-1}$ and $e_{2t-1}$ are the lagged residuals from equations (4.14) and (4.15).

The Granger causality test is based on the standard $F$-statistic which is calculated for each equation using the constrained and unconstrained form of each equation. The Granger causality test may result in four possible conclusions:

(a) Unidirectional causality from $\Delta Y_t$ to $\Delta X_t$ is indicated if the estimated coefficients on the lagged $\Delta Y_t$ are statistically different from zero as a group ($\Sigma a_i \neq 0$) and the set of coefficients on the lagged $\Delta X_t$ is not statistically different from zero ($\Sigma \lambda_i = 0$);

(b) Conversely, unidirectional causality from $\Delta X_t$ to $\Delta Y_t$ exists if the set of lagged $\Delta X_t$ coefficients are not statistically different from zero ($\Sigma a_i = 0$) and the set of the lagged $\Delta Y$ coefficients are statistically different from zero ($\Sigma \lambda_i \neq 0$);

(c) Bidirectional causality is suggested when the set of $\Delta Y_t$ and $\Delta X_t$ coefficients are statistically significantly different from zero in both equations;

(d) Finally, independence is indicated when the sets of $\Delta Y_t$ and $\Delta X_t$ coefficients are not statistically significant in both equations.

In addition, in the error correction models, a new channel of causality may emerge because of the significant $\phi$'s which implies that the changes in the first series may be due to movements in the second series towards an alignment with the trend value of the first series. Such causality can only be detected by using the cointegration or error correction models (Lin and Swanson, 1993).

#### *4.4.1.4: Variance Decomposition and Impulse Response Function Analysis*

Eun and Shim (1989) used a VAR model to derive the impulse response and decompose variance. The VAR model is expressed as:

$$\Delta Y(t) = C + \sum_{s=1}^{m} A(s)\, Y\,(t-s) + e(t) \tag{4.18}$$

Where $\Delta Y(t)$ is a vector of weekly returns of the four stock markets, $C$ and $A(s)$ are matrices of coefficients, $m$ is the lag length, and $e(t)$ is the vector of forecast errors of the best linear predictor of $Y(t)$ using all the past $Y(s)$. The *i*, *j*th components of the $A(s)$ vector estimate the direct effect that a change in the return to the *j*th market would have on the *i*th market in *s* periods. In order to analyse how a random shock in a particular market affects prices in other markets, the VAR model can be expressed as a moving average representation since the $e(t)$, although serially uncorrelated, are contemporaneously correlated. The representation is as follows:

$$Y(t) = \sum_{s=0}^{\infty} B(s)\, e(t-s) \tag{4.19}$$

Where $Y(t)$ represents a linear combination of current and past one-step ahead forecast errors or innovations. The *i*, *j*th components of *B(s)* indicates the responses of the *i*th market in *s* periods after a unit shock in the *j*th market and none in other markets.

The structure of the response of each market to a unit shock in another market within *s* periods can be determined by transforming the innovations into orthogonalised innovations through the Cholesky decomposition (Eun and Shim, 1989). It is done as follows:

Let $e = Vu$ where $V$ is a lower triangular matrix operator and $u$ is orthogonalised innovations such that $Ee' = S$ , $VV' = S$, and $u(t)$ has an identity covariance matrix. Equation (4.19) then becomes:

$$Y(t) = \sum_{s=0}^{\infty} B(s)\, Vu(t-s)$$

$$= \sum_{s=0}^{\infty} C(s)\, u(t-s) \qquad (4.20)$$

Where $C(s) = B(s)V$. Then the *i*, *j*th component of $C(s)$ represents the impulse response of the *i*th market in *s* periods to a shock of one standard error in the *j*th market.

The forecast variance of each market's price can also be broken up into portions accounted for by shocks and price innovations transmitting from other markets. The orthogonalisation of innovations provides the quantity, $\sum_{s=0}^{T} Cij^2(s)$, which is the component of forecast error variance in the *T+1* step ahead forecast of $Y_i$ which is accounted for by innovations in $Y_j$. The decomposition of forecast error variance provides a measure of the overall relative importance of the markets in generating the fluctuations in stock returns in their own and other markets.

According to Brooks (2008), the ordering of variables is important for calculating impulse response functions and variance decompositions; the results may not be consistently supported by the ordering of the variables and different results may emerge for different orderings of the series. In addition, Runkle (1987) has argued that reporting impulse response function analysis without confidence intervals is equivalent to reporting regression coefficients without *t*-statistics. In the current thesis, the Generalised Impulse Response Function analysis of Pesaran and Shin (1998) and the variance decomposition procedure of Hasbrouck (1995) is used. This analysis has the advantage that the results are invariant to the ordering of the variables in a VAR model

(Chuang et al., 2007). In addition, the confidence intervals are reported with the impulse response function analysis as to make the output about the short-term dynamics of the four South Asian markets more meaningful.

### 4.4.2: Principal Components Analysis

The idea of PCA was first introduced by Pearson (1901), and was later independently developed by Hotelling (1933). It is a technique which linearly transforms a large number of variables into a substantively smaller set of uncorrelated variables that represent most of the information in the original set of variables (Dunteman, 1994). The original set of variables is assumed to be highly correlated when there are only a few important sources of information in the data that are common to many variables (Alexander, 2001).

In the current thesis, 12 macroeconomic variables including seven local (Consumer Price Index, Foreign Exchange Rate, Industrial Production Index, Exports, Imports, Money Supply and Treasury Bill Rate) and five global (World Consumer Price Index, World Gross Domestic Product, Oil Prices, US Treasury Bill Rate and World Market Return) variables are investigated to see if they are linked to changes in equity returns for the four South Asian markets of Bangladesh, India, Pakistan and Sri Lanka. The variables were selected because they were found to have a relationship with share price changes in previous studies (Harvey, 1995; Fifield et al., 2002; Fifield and Power, 2006)[113]. However, these prior studies have suggested that many of the macroeconomic variables are correlated with one another. Dunteman (1994) argued that when the variables under investigation are highly correlated, they can be linearly transformed into a small number of uncorrelated variables which will explain most of the variation in the original

[113] From the correlation analysis in Chapter 6, it is evident that these variables have significantly higher correlations among each other in general and with the share price changes in particular. These significantly higher correlations among the variables make it difficult to use them as independent variables in the subsequent analysis.

set of variables. The derived variables are known as principal components (PCs). By using PCA, the dimensionality of the data set would thus reduce from the '$p$' correlated dimensions to a small number of '$k$' uncorrelated dimensions and considerably simplify the analysis of the macroeconomic variables.

PCA searches for a few uncorrelated linear combinations of the original variables that capture most of the information in the original variables. For example, a set of '$p$' macroeconomic variables which can be characterised as a '$p$' dimension random vector (*X1*, *X2*,........, *Xp*) can be linearly transformed into a one dimensional $Y$ as ( $Y = a_1x_1 + a_2x_2 + \dots\dots + a_px_p$). In PCA, the weights ( $a_1, a_2, \dots\dots, a_p$) are mathematically determined to maximise the variation in the linear composite or, equivalently, to maximise the sum of the squared correlations of the principal components with the original set of variables. The principal components are ordered with respect to their explanation of variations in the original variables so that only a few principal components account for most of the variation. In addition, the first few principal components have the highest possible squared multiple correlations with each of the original variables (Dunteman, 1994). When the variables are correlated, there can be fewer principal components than the number of variables. Using all possible principal components would have the same dimensions as the number of variables. However, the advantage of PCA is in using fewer principal components in comparison to the number of variables.

The first principal component PC1, denoted by $Y_1$, is a linear combination of the variables so that:

$$Y_1 = a_{11}x_1 + a_{12}x_2 + \dots\dots + a_{1p}x_p = \sum_{i=1}^{p} a_{1i}\, x_i \qquad (4.21)$$

Where $a_{1i}$ represents the weights of the variables in forming the principal components and $x_i$ represents the relative variables in the principal components. The variance of the first principal component $Y_1$ is maximised given the constraint that the sum of the squared weights is equal to one, that is $\sum_{i=1}^{p} a_{1i}^2 = 1$. When the variance of $Y_1$ is maximised then the sum of the squared correlation of $Y_1$ with the original variables, that is $\sum_{i=1}^{p} r_{y,xi}^2$, is also maximised. PCA finds the optimal weight vector $(a_{11}, a_{12}, \dots \dots .., a_{1p})$ and the associated variance of $Y_1$ which is usually denoted by $\lambda_1$. The second principal component, denoted by $Y_2$, involves finding a second weight vector $(a_{21}, a_{22}, \dots \dots ., a_{2p})$ and the variance of $Y_2$ is:

$$Y_2 = a_{21}x_1 + a_{22}x_2 + \dots \dots + a_{2p}x_p = \sum_{i=1}^{p} a_{2i}\, x_i \qquad (4.22)$$

The variance of the second principal component $Y_2$ is maximised subject to the constraint that it is uncorrelated with the first principal component. This results in $Y_2$ having the next largest sum of squared correlations with the original variables. The sum of squared correlations or the variances of the principal components get smaller with the extraction of each successive principal component.

The PCA method is useful when the variables are highly correlated (Dunteman, 1994). Using the "raw" variables will result in a multicollinearity problem in the regression analysis. But this method has some limitations as well. When PCA is used to extract PCs from macroeconomic variables, a number of criticisms have been put advanced. According to Dunteman (1994), when several variables in the principal component vectors have large coefficients of either sign, it can often be difficult to interpret the principal components. In the current thesis this limitation was not a big concern as, in each of the four markets, the identity of the high loading variables in each PC vector was relatively unambiguous. In addition, although criteria for deciding on how many PCs to extract for further analysis are provided in the literature, the final choice on the number of PCs used is subjective (Dunteman, 1994). Finally, although the PCs explain most of the variation in the original variables, they may not be the most useful as explanations for dependent variables (Brooks, 2008). Therefore, in the current thesis, although the PCs explain most of the variation in the original local and international economic factors, they may not be the most useful explanatory factors for predicting South Asian emerging stock market share returns.

### 4.4.3: The Multivariate GARCH-BEKK Model

To investigate the linkages among the four South Asian stock markets in greater depth, the multivariate GARCH model involving the parameterisation of Baba, Engle, Kraft and Kroner (BEKK) is used[114]. The VAR-GARCH-BEKK model form is used to examine return and volatility spillovers among the markets[115]. The GARCH-BEKK model was selected for the current thesis based on a number of important considerations. Specifically, the GARCH-BEKK model overcomes difficulties with the *vech* formulation. The $vech$ model formulation has two main problems; first, the number of parameters to be estimated under the $vech$ formulation is large. For example, according to Bauwens et al. (2006) the number of parameters is $N(N + 1)(N(N + 1) + 1)/2$ (for $N = 4$ it is equal to 210) where $N$ indicates the number of variables in the system. For the BEKK formulation the number of parameters to be estimated is reduced to $N(5N + 1)/2$ (for $N = 4$ it is equal to 42). Second, in the *vech* formulation, restrictions are needed on the parameters to ensure that the conditional variance matrix is positive definite. Engle and Kroner (1995) proposed the BEKK parameterisation for $H_t$, to overcome the above two problems. In addition, the GARCH-BEKK model is superior to its diagonal model counterparts where each element of the matrix depends only on its own lagged values of shocks and volatility. The GARCH-BEKK model takes into account own as well as cross-market shocks and volatility,

[114] The BEKK acronym for Baba, Engle, Kraft and Kroner is used in the literature for their unpublished work undertaken in 1990 (Hassan and Malik, 2007). The multivariate form of the model was later developed by Engle and Kroner (1995).
[115] Chuang et al. (2007) argued that for international investors, both return and volatility interactions are important for making investment decisions.

and hence examines both direct and indirect effects of volatility spillover. The current thesis therefore, used the complete information GARCH-BEKK model.

The return spillovers among the markets are examined by the mean equation in the GARCH model, whereas the variance – covariance equations investigate the volatility spillovers in and across the four markets[116]. The mean equation of the following form is used:

$$R_t = \mu + \Gamma R_{t-1} + \varepsilon_t \qquad \varepsilon_t | I_{t-1} \sim N(0, H_t) \qquad (4.23)$$

Where $R_t$ is a *4×1* vector of weekly returns at time *t* and Γ is a *4×4* matrix of parameters associated with the lagged returns. The diagonal elements in matrix Γ are $\gamma_{ii}$which measure the effects of own past returns. The off-diagonal elements of the matrix Γ are $\gamma_{ij}$, which capture the relation in terms of return spillover effects across the markets. $\varepsilon_t$ is a *4×1* vector of random error terms. $\varepsilon_t$ is the innovation for each market at time *t* and has a *4×4* conditional variance-covariance matrix, $H_t$. $I_{t-1}$ represents the market information available at time *t-1*. μ represents a *4×1* vector of constants.

Bollerslev et al. (1988) argued that $H_t$ is a linear function of the lagged squared errors. The cross product of errors and lagged values of the elements of $H_t$ are as follows:

$$vech(H_t) = vech(C) + \sum_{i=1}^{q} A_i \, vech(\varepsilon_{t-1}\varepsilon'_{t-i}) + \sum_{i=1}^{p} G_i \, vech(H_{t-i}) \qquad (4.24)$$

Where $vech$ is the operator that stacks the lower triangular portion of a symmetric matrix into a vector. The $vech$ model formulation has two main problems; first, the number of parameters to be estimated under the $vech$ formulation is large. Second, restrictions are needed on the

[116] According to Hassan and Malik (2007), a model having more than three variables is considered to be superior to one with fewer variables since it captures all the interactions in the second moment among the variables simultaneously.

parameters to ensure that the conditional variance matrix is positive definite. Engle and Kroner (1995) proposed the BEKK parameterisation for $H_t$, to overcome the above two problems.

$$H_t = C'C + A'\varepsilon'_{t-1}\varepsilon_{t-1}A + G'H_{t-1}G \tag{4.25}$$

The individual elements for the *A*, *G* and *C* matrices in equation (4.25) are given as follows:

$$A = \begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix} G = \begin{bmatrix} g_{11} & g_{12} & g_{13} & g_{14} \\ g_{21} & g_{22} & g_{23} & g_{24} \\ g_{31} & g_{32} & g_{33} & g_{34} \\ g_{41} & g_{42} & g_{43} & g_{44} \end{bmatrix} C = \begin{bmatrix} c_{11} & 0 & 0 & 0 \\ c_{21} & c_{22} & 0 & 0 \\ c_{31} & c_{32} & c_{33} & 0 \\ c_{41} & c_{42} & c_{43} & c_{44} \end{bmatrix} \tag{4.26}$$

Where *C* is a *4×4* lower triangular matrix with 10 parameters, *A* is a 4×*4* square matrix of parameters and shows how conditional variances are correlated with past squared errors. The elements of matrix *A* measure the effects of shocks or 'news' on conditional variances. *G* is also a *4×4* square matrix of parameters and shows how past conditional variances affect current levels of conditional variances. The diagonal parameters in matrix $A$ and matrix $G$ (that is, $a_{ii}, g_{ii}$) measure the effects of own past shocks and past volatility of a market $i$ on its conditional variance. The off-diagonal parameters in matrix $A$ and matrix $G$ (that is, $a_{ij}, g_{ij}$) measure the cross-market effects of shocks and volatility[117]. The total number of estimated elements for the variance equations for the multivariate case is 42.

The conditional variance for each equation, excluding constant terms, can be expanded for the multivariate GARCH (1, 1) as:

$$\begin{aligned} h_{11} = {} & a_{11}^2\varepsilon_{1,t-1}^2 + 2a_{11}a_{21}\varepsilon_{1,t-1}\varepsilon_{2,t-1} + 2a_{11}a_{31}\varepsilon_{1,t-1}\varepsilon_{3,t-1} + 2a_{11}a_{41}\varepsilon_{1,t-1}\varepsilon_{4,t-1} \\ & + a_{21}^2\varepsilon_{2,t-1}^2 + 2a_{21}a_{31}\varepsilon_{2,t-1}\varepsilon_{3,t-1} + 2a_{21}a_{41}\varepsilon_{2,t-1}\varepsilon_{4,t-1} + a_{31}^2\varepsilon_{3,t-1}^2 \\ & + 2a_{31}a_{41}\varepsilon_{3,t-1}\varepsilon_{4,t-1} + a_{41}^2\varepsilon_{4,t-1}^2 + g_{11}^2h_{11,t-1} + 2g_{11}g_{21}h_{12,t-1} \\ & + 2g_{11}g_{31}h_{13,t-1} + 2g_{11}g_{41}h_{14,t-1} + g_{21}^2h_{22,t-1} + 2g_{21}g_{31}h_{23,t-1} \\ & + 2g_{21}g_{41}h_{24,t-1} + g_{31}^2h_{33,t-1} + 2g_{31}g_{41}h_{34,t-1} + g_{41}^2h_{44,t-1} \end{aligned} \tag{4.27}$$

[117] This effect is known as a volatility spillover effect; it may be from a country's own lagged returns or volatility and from other markets; these are described by their respective coefficients.

$$
\begin{aligned}
h_{22} = \; & a_{12}^2\varepsilon_{1,t-1}^2 + \; 2a_{12}a_{22}\varepsilon_{1,t-1}\varepsilon_{2,t-1} + 2a_{12}a_{32}\varepsilon_{1,t-1}\varepsilon_{3,t-1} + 2a_{12}a_{42}\varepsilon_{1,t-1}\varepsilon_{4,t-1} \\
& + a_{22}^2\varepsilon_{2,t-1}^2 + 2a_{22}a_{32}\varepsilon_{2,t-1}\varepsilon_{3,t-1} + 2a_{22}a_{42}\varepsilon_{2,t-1}\varepsilon_{4,t-1} + a_{32}^2\varepsilon_{3,t-1}^2 \\
& + 2a_{32}a_{42}\varepsilon_{3,t-1}\varepsilon_{4,t-1} + a_{42}^2\varepsilon_{4,t-1}^2 + g_{12}^2h_{11,t-1} + 2g_{12}g_{22}h_{12,t-1} \\
& + 2g_{12}g_{32}h_{13,t-1} + 2g_{12}g_{42}h_{14,t-1} + g_{22}^2h_{22,t-1} + 2g_{22}g_{32}h_{23,t-1} \\
& + 2g_{22}g_{42}h_{24,t-1} + g_{32}^2h_{33,t-1} + 2g_{32}g_{42}h_{34,t-1} + g_{42}^2h_{44,t-1}
\end{aligned} \tag{4.28}
$$

$$
\begin{aligned}
h_{33} = \; & a_{13}^2\varepsilon_{1,t-1}^2 + \; 2a_{13}a_{23}\varepsilon_{1,t-1}\varepsilon_{2,t-1} + 2a_{13}a_{33}\varepsilon_{1,t-1}\varepsilon_{3,t-1} + 2a_{13}a_{43}\varepsilon_{1,t-1}\varepsilon_{4,t-1} \\
& + a_{23}^2\varepsilon_{2,t-1}^2 + 2a_{23}a_{33}\varepsilon_{2,t-1}\varepsilon_{3,t-1} + 2a_{23}a_{43}\varepsilon_{2,t-1}\varepsilon_{4,t-1} + a_{33}^2\varepsilon_{3,t-1}^2 \\
& + 2a_{33}a_{43}\varepsilon_{3,t-1}\varepsilon_{4,t-1} + a_{43}^2\varepsilon_{4,t-1}^2 + g_{13}^2h_{11,t-1} + 2g_{13}g_{23}h_{12,t-1} \\
& + 2g_{13}g_{33}h_{13,t-1} + 2g_{13}g_{43}h_{14,t-1} + g_{23}^2h_{22,t-1} + 2g_{23}g_{33}h_{23,t-1} \\
& + 2g_{23}g_{43}h_{24,t-1} + g_{33}^2h_{33,t-1} + 2g_{33}g_{43}h_{34,t-1} + g_{43}^2h_{44,t-1}
\end{aligned} \tag{4.29}
$$

$$
\begin{aligned}
h_{44} = \; & a_{14}^2\varepsilon_{1,t-1}^2 + \; 2a_{14}a_{24}\varepsilon_{1,t-1}\varepsilon_{2,t-1} + 2a_{14}a_{34}\varepsilon_{1,t-1}\varepsilon_{3,t-1} + 2a_{14}a_{44}\varepsilon_{1,t-1}\varepsilon_{4,t-1} \\
& + a_{24}^2\varepsilon_{2,t-1}^2 + 2a_{24}a_{34}\varepsilon_{2,t-1}\varepsilon_{3,t-1} + 2a_{24}a_{44}\varepsilon_{2,t-1}\varepsilon_{4,t-1} + a_{34}^2\varepsilon_{3,t-1}^2 \\
& + 2a_{34}a_{44}\varepsilon_{3,t-1}\varepsilon_{4,t-1} + a_{44}^2\varepsilon_{4,t-1}^2 + g_{14}^2h_{11,t-1} + 2g_{14}g_{24}h_{12,t-1} \\
& + 2g_{14}g_{34}h_{13,t-1} + 2g_{14}g_{44}h_{14,t-1} + g_{24}^2h_{22,t-1} + 2g_{24}g_{34}h_{23,t-1} \\
& + 2g_{24}g_{44}h_{24,t-1} + g_{34}^2h_{33,t-1} + 2g_{34}g_{44}h_{34,t-1} + g_{44}^2h_{44,t-1}
\end{aligned} \tag{4.30}
$$

Equations (4.27) - (4.30) show how shocks and volatility are transmitted across the four markets and over time[118]. For the four markets in this thesis, the transmission mechanism is examined by estimating a multivariate GARCH model which includes the four stock markets of the South Asian region.

The BEKK model in equation (4.25) can be estimated efficiently and consistently using the full information maximum likelihood method. The log likelihood function of the joint distribution is the sum of all the log likelihood functions of the conditional distribution; that is, the sum of the

[118] The coefficient terms in equations (4.27) - (4.30) are a non-linear function of the estimated elements from equation (4.25). More details are provided in Kearney and Patton (2000).

logs of the multivariate normal distribution. Letting $L_t$ be the log likelihood of observation *t*, *n* be the number of stock markets and $L$ be the joint log likelihood gives:

$$L = \sum_{t=1}^{T} L_t \, , \qquad\qquad L_t = \frac{n}{2}\ln(2\pi) - \frac{1}{2}ln|H_t| - \frac{1}{2}\varepsilon_t' H_t^{-1}\varepsilon_t \qquad (4.31)$$

Under the assumption that the random errors are normally distributed, the log likelihood function for the multivariate GARCH model is estimated using a Quasi Maximum Likelihood approach (Bollerslev and Wooldridge, 1992). The Broyden, Fletcher, Goldfarb and Shanno (BFGS) algorithm is used to produce the maximum likelihood parameter estimates and their corresponding asymptotic standard errors[119].

### 4.5: Conclusion

The current chapter outlines various philosophical assumptions which underpin social science research in general as well as the assumptions which inform the current thesis. The assumptions underpinning the nature of social sciences and society result in the four paradigms proposed by Burrell and Morgan (1979). This discussion is then followed by a description of the methodology and methods adopted for undertaking the research in this thesis. In particular, the current research employs quantitative methods to investigate linkages among four emerging stock markets of South Asia. In particular, the Johansen cointegration analysis is used to investigate the long-run relationships among the markets, while the short-run linkages among the markets are examined using a VECM, Granger causality tests, Generalised Impulse Response Function analysis and variance decomposition analysis. The results from these methods are discussed in Chapter 5. To examine the relationships among share price changes and the local and global

[119] The BFGS algorithm has been used in various recent articles: for example, Kanas (1998), Hassan and Malik (2007) and Eissa et al. (2010). The researcher also tried the Berndt, Hall, Hall and Hausman (BHHH) algorithm, but the BFGS was found to perform better in terms of model convergence.

macroeconomic variables, PCA and regression analysis are employed. The findings from the PCA and regression analysis are discussed in Chapter 6. In Chapter 7, the results from using the multivariate GARCH-BEKK model are discussed. The model provides results for return and volatility spillovers in and across the four emerging stock markets. These results further investigate the interactions among the South Asian markets examined in this thesis.

# Chapter 5

## Stock Market Integration and Dynamic Linkages Between the Four South Asian Emerging Stock Markets

## 5.1: Introduction

Interest in international stock market integration has grown during the last three decades - especially after the 1987 global stock market crash. This interest has been further enhanced by several recent economic developments among countries at a regional level including improved policy co-ordination (Diamandis, 2009), relaxation of capital control measures (Masih and Masih, 2002), improvements in communication (Alkulaib et al., 2009), developments in trading system technologies (Maghyereh, 2006) and the introduction of new financial products such as country funds (Phylaktis and Ravazzolo, 2005; Diamandis, 2009). These developments have resulted in the speedy dissemination of information among markets, reduced transaction costs and improved access to emerging markets for foreign investors.

The issue of stock market integration is of importance for two main reasons. First, if stock markets are integrated in the long-run and share a common stochastic trend then long-run diversification benefits may be limited. The potential for diversification will depend on how many stochastic trends are present. Hence, cointegration among the markets has implications for long-run diversification potential by providing information about whether markets tend to move together over time. Second, according to Granger (1986), two or more asset prices cannot be cointegrated within an efficient market since evidence of cointegration would suggest that prices are predictable based on historical price information from own and other markets. Hence, findings of cointegration call the EMH in to question[120].

This research contributes to the rather sparse literature on the level of integration between emerging markets by examining the extent of both long-run and short-run integration and the effect of 9/11 on the relationships among weekly stock price indices from the South Asian region

[120] However, Diamandis (2009) argued that findings of cointegration among stock market prices may not necessarily violate market efficiency because the cointegration of fundamentals may also lead to cointegration among stock prices. In the current analysis, the Vector Error Correction Model (VECM) and variance decomposition analysis along with impulse response function is also included to further investigate the weak form of the EMH.

over the period 1993-2010. The relationship among the four South Asian markets of Bangladesh, India, Pakistan and Sri Lanka are examined using the Johansen cointegration framework. In addition to the long-run analysis, short-run relationships among the markets are investigated by estimating the VECM for the markets and conducting Granger causality tests, impulse response function analysis and variance decomposition analysis.

The remainder of the chapter is organised as follows. Section 5.2 presents a preliminary analysis of the data and reports the descriptive statistics. Section 5.3 reports the unit root test results. To analyse the long-run integration among the markets, Section 5.4 highlights the results for the cointegration analysis and discusses the implications of the findings. Section 5.5 describes the results for the Vector Error Correction Model. Section 5.6 then discusses the empirical results for Granger Causality. In Sections 5.7 and 5.8, the variance decomposition and impulse response function analysis results are highlighted. Finally, Section 5.9 outlines the conclusion.

## 5.2: Data and Descriptive Statistics

Data consisted of weekly share price indices for stock markets in Bangladesh, India, Pakistan and Sri Lanka over the time period January 1993 through December 2010; a total of 938 observations were available for analysis[121]. In particular, weekly data on the Bangladesh All Share Price Index (BDSE), the Indian National-200 Price Index (BSE), the Karachi SE-100 Price Index (PKSE) and the Sri Lanka All Share Price Index (SRLK) were obtained from Datastream. As Chapter 2 indicated, the choice of these markets was determined mainly by the availability of data, the relatively large size of these markets in the region and the expected financial and

[121] Other studies which have focused on this area, such as Narayan et al. (2004) and Lamba (2005) used daily share price data for 1995-2001 and 1997-2003, respectively.

economic linkages between these markets. All index prices were obtained in local currencies[122]. Returns from the share index data were calculated for each market according to the formula[123]:

$$R_{it} = \ln(P_{it}) - \ln(P_{it-1}) \tag{5.1}$$

Where $R_{it}$ is the return on index *i* in week *t*, $P_{it}$ is the price level of the index in week *t*, $P_{it-1}$ represents the price level of the index for the previous week, and $Ln$ represents the natural logarithm.

Descriptive statistics were calculated for the weekly nominal return series of the four South Asian markets in their local currencies over the whole 18-year time period and for the two sub-periods. In particular, the number of observation (N), the mean (Mean), the median (Median), the standard deviation (Std. Dev), and maximum (Maximum) and minimum (Minimum) values are reported. In addition, skewness (Skewness) and kurtosis (Kurtosis) statistics were calculated in order to examine the symmetry of the return distribution. Table 5.1 also details the results of the Jarque-Bera test which examines the normality of the return series in the four markets.

A number of points emerged from the analysis of the descriptive statistics in Table 5.1. First, the number of weekly observations for the entire period represents quite a long time span; the results should not be specific to one particular time span when unusual economic conditions prevailed. Second, the mean return varied across the four markets. Bangladesh performed the best with a mean return of 0.31 per cent per week. This was followed by Pakistan and Sri Lanka with mean returns of 0.24 per cent per week each. The worst performing market was India (the largest in the region), with a mean return of only 0.22 per cent per week. The average weekly return for these

[122] Click and Plummer (2005) found that currency denominations have no impact on the results for ASEAN-5 stock markets. They analysed the cointegration of these markets in local currencies, in US Dollars and in Japanese Yen and obtained almost identical results for each of the currencies.

[123] The returns analysed in this thesis were estimated in nominal terms since these are the performance measures which are mostly used by the investors (Modigliani and Cohn, 1979). In addition, the thesis used weekly data for share returns. However, data for the consumer price index and inflation were not available on a weekly basis for the four markets.

countries was estimated to be 0.25 per cent. The mean returns were positive for all four markets in the region with an average value above 0.20 per cent per week.

Third, returns of the four markets were volatile with all markets recording standard deviation values above 3.00 per cent per week during the entire period. Surprisingly, Sri Lanka was the least (*ex post*) risky market with a standard deviation of 3.36 per cent per week despite the civil war which persisted during this time frame. India was the market with the highest standard deviation value of 4.14 per cent. Bangladesh and Pakistan had standard deviations of 4.11 per cent and 4.09 per cent, respectively. The spreads between the maximum and minimum values confirm that the returns in these four markets were volatile. Bangladesh showed the highest spread of 0.7735[124]. This large range was due to the stock market crash in Bangladesh during 1996. Solaiman (2006) described the "Share Scam" of 1996[125], which involved four foreign institutional investors; two Dhaka Stock Exchange members; and a Security and Exchanges Commission member, and culminated in a bubble which preceded this crash. He further reported that each institutional investor hired 100 young people to create an artificial demand for Bangladeshi securities without any economic justification. All of these manipulations resulted in the market crash of 1996 (Solaiman, 2006). Pakistan showed the smallest spread of 0.3639 during the whole period; this is again surprising given the political turbulence which took place in Pakistan from 1998 to 2006. However, what the findings show is the volatile nature of equity returns in these four ESMs (see Figures 5.5 to 5.8).

Fourth, according to portfolio theory, higher risk should be associated with higher expected return, but this is not apparent from the descriptive statistics in Table 5.1; in contrast to the

[124] In a more recent study, Mobarek et al. (2008) argued that investors lacked confidence in the market due to the market crash after November 1996 which witnessed the highest points in the history of the market. This is evident from Figure 5.2 which shows the highest spike during 1996 that then plummets in subsequent months of 1996 and 1997.

[125] The elected regime installed in June 1996 relaxed the restrictions on investment in Bangladesh due to which foreign institutional investors were attracted. These investors employed 400 young people who persuaded the illiterate people with the hope of earning more money from securities investment in a short period of time. Although the economy was performing poorly, the stock market was performing phenomenally due to the artificial demand. As a result the market crashed late in 1996, (Sulaiman, 2006).

theory, the mean return in India was the lowest despite the fact that its ex post risk was highest. Similarly, Sri Lankan equities earned the same mean return as Pakistan although the former exhibited lower risk.

Fifth, returns in India and Pakistan were negatively skewed with statistics of -0.5196 and -0.8678, respectively. The distribution of returns in these two markets exhibited some extreme negative values. By contrast, returns in Bangladesh and Sri Lanka were positively skewed during the entire period suggesting that these markets offered more attractive investment opportunities for risk averse investors; in all cases the skewness statistics were statistically different from what one expect in a normal distribution. The kurtosis and Jarque-Bera test results confirm that the distributions of equity returns were not normal in these four markets. Kurtosis values were all greater than three, with Bangladesh showing the highest value of 31.5717[126]. The Jarque-Bera test results showed that the null hypothesis of normally distributed data was strongly rejected at the one per cent level of significance for all four markets[127]. Finally, descriptive statistics were also calculated for the two sub-periods to examine whether the results for the whole time frame were relatively consistent throughout these 18 years. Specifically, the data were split into the first sub-period from 1993 to 2001 and the second sub-period 2002 to 2010 and summary information estimated; the statistics are reported in Tables 5.2 and 5.3, respectively. An analysis of these tables reveals that returns in the second sub-period were higher, less volatile and more negatively skewed than their first sub-period counterparts.

[126] A normal distribution has a kurtosis of three. Distributions which have a kurtosis value of greater than three is more peaked as compared to a normal distribution, while distributions that have a kurtosis value of less than three is flat as compared to a normal distribution.

[127] The Jarque-Bera test is used to test for the normality of the residuals. It measures the skewness and kurtosis of the series with those of a normal distribution. In this analysis, the null hypothesis of normality for all the four series was rejected at the one per cent level because of higher test statistic values than the critical values at the one per cent level. In addition, the p-values are all highly significant.

**Table 5.1: Summary Statistics of the Stock Index Returns for the Four South Asian Markets for the Whole Period 05/01/1993 – 28/12/2010.**

| Statistic | Country | | | |
|---|---|---|---|---|
| | **Bangladesh** | **India** | **Pakistan** | **Sri Lanka** |
| **N** | 938 | 938 | 938 | 938 |
| **Mean** | 0.0031 | 0.0022 | 0.0024 | 0.0024 |
| **Median** | 0.0001 | 0.0054 | 0.0044 | 0.0014 |
| **Maximum** | 0.4604 | 0.1682 | 0.1425 | 0.2604 |
| **Minimum** | -0.3131 | -0.2295 | -0.2214 | -0.1693 |
| **Std. Dev** | 0.0411 | 0.0414 | 0.0409 | 0.0336 |
| **Skewness** | 1.1658* | -0.5196* | -0.8678* | 0.5641* |
| **Kurtosis** | 31.5717* | 5.4911* | 6.6978* | 9.3710* |
| **Jarque-Bera** | 32117.86* | 284.74* | 652.17* | 1636.11* |

Descriptive statistics are included in the table. N is the number of observations, Mean is the equally- weighted average of all weekly observations over the whole 18-year time period. Median is the middle value of the series. Std. Dev indicates the standard deviation of the return series. Minimum and Maximum indicate the lowest and highest returns, respectively. Skewness is the Kendall-Stuart measure of Skewness and Kurtosis is the Kendall-Stuart measure of Kurtosis. The Jarque-Bera test results are shown to test normality for the weekly return series of the four South Asian emerging markets. An * indicates significance at the five per cent level.

**Table 5.2: Summary Statistics of the Stock Index Returns in Local Currencies for the Four South Asian Markets for Sub-Period 1: 05/01/1993 – 26/06/2001.**

| Statistic | Country | | | |
|---|---|---|---|---|
| | **Bangladesh** | **India** | **Pakistan** | **Sri Lanka** |
| **N** | 442 | 442 | 442 | 442 |
| **Mean** | 0.0015 | 0.0003 | 0.0002 | -0.0002 |
| **Median** | -0.0001 | 0.0001 | 0.0005 | -0.0011 |
| **Maximum** | 0.4604 | 0.1532 | 0.1425 | 0.1458 |
| **Minimum** | -0.3131 | -0.1628 | -0.2214 | -0.1693 |
| **Std. Dev** | 0.0505 | 0.0428 | 0.0445 | 0.0321 |
| **Skewness** | 1.2604* | -0.1624 | -0.6672* | 0.2539 |
| **Kurtosis** | 25.0324* | 4.0682* | 6.1637* | 7.2183* |
| **Jarque-Bera** | 9056.95* | 22.96* | 217.12* | 332.46* |

Descriptive statistics are included in the table. N is the number of observations, Mean is the equally- weighted average of the weekly observations for sub-period 1 over the period 05/01/1993 to 26/06/2001. Median is the middle value of the series. Std. Dev indicates the standard deviation of the return series. Minimum and Maximum indicates the lowest and highest returns, respectively. Skewness is the Kendall-Stuart measure of skewness, and Kurtosis is the Kendall-Stuart measure of kurtosis. The Jarque-Bera test results are shown to test normality for the weekly return series of the four South Asian emerging markets. An * indicates significance at the five per cent level.

**Table 5.3: Summary Statistics of the Stock Index Return in Local Currencies for the Four South Asian Markets for Sub-Period 2: 01/01/2002 – 28/12/2010.**

| Statistic | Country | | | |
|---|---|---|---|---|
| | **Bangladesh** | **India** | **Pakistan** | **Sri Lanka** |
| **N** | 469 | 469 | 469 | 469 |
| **Mean** | 0.0045 | 0.0042 | 0.0047 | 0.0041 |
| **Median** | 0.0001 | 0.0087 | 0.0081 | 0.0045 |
| **Maximum** | 0.1757 | 0.1682 | 0.1104 | 0.1454 |
| **Minimum** | -0.2614 | -0.2295 | -0.1985 | -0.1355 |
| **Std. Dev** | 0.0274 | 0.0403 | 0.0371 | 0.0319 |
| **Skewness** | -1.5230* | -0.8660* | -1.1890* | -0.1525 |
| **Kurtosis** | 25.1120* | 7.2134* | 7.4075* | 5.7387* |
| **Jarque-Bera** | 9736.07* | 405.55* | 490.13* | 148.39* |

Descriptive statistics are included in the table. N is the number of observations, Mean is the equally- weighted average of the weekly observations for sub-period 2 over the period 01/01/2002 to 28/12/2010. Median is the middle value of the series. Std. Dev indicates the standard deviation of the return series. Minimum and Maximum indicates the lowest and highest returns, respectively. Skewness is the Kendall-Stuart measure of skewness and Kurtosis is the Kendall-Stuart measure of kurtosis. Jarque-Bera test results are shown to test normality for the weekly return series of the four South Asian emerging markets. An * indicates significance at the five per cent level.

One of the benefits from portfolio diversification into emerging markets is that the returns from these countries' securities are less correlated than those of the developed markets (Harvey 1995). According to this way of thinking, investors adding securities from emerging markets may be able to reduce their risk while earning the same or even higher returns (Middleton et al., 2008). To investigate this possibility, the correlations between each of the markets in the sample were calculated for the entire period and for the two sub-periods. Table 5.4 shows the Pearson correlation coefficients between the weekly returns of each pair of South Asian markets over the entire 18-year test period and for the two sub-periods[128]. It is apparent from the table that the correlations between the four markets are low and, in some cases, negative. For example, the lowest correlation in the sample is reported for Bangladesh and India (-0.0038) for the entire period. Surprisingly, the highest value of 0.1491 is reported for Pakistan and India; one would

[128] The reasons for dividing the sample are (i) to look for the changes in the correlations during the 18-year time period; and (ii) to look for the effect of global events of importance (September 11, 2001 US attacks) on the correlations of the four markets. It seems likely that such events of global importance would have an impact on equity return correlations and hence on the benefits from international portfolio diversification (Meric et al., 2008).

have thought that the conflict between the two countries might have reduced any correlation present. However, these average correlations hide the fact that the associations between the equity returns in these markets vary over time. For example, the correlation between Bangladesh and India changed from negative to positive between the first and second sub-periods whereas the statistics for Pakistan and Sri Lanka moved from positive to negative (-0.0212) over the same sub-periods. Panel D shows the percentage increase (decrease) in the correlations during the pre- and post-September 11, 2001 periods. It is evident from Panel D that overall correlations increased from the first to the second period with two exceptions; the correlation between Pakistan and Sri Lanka decreased by 21.11 per cent while the correlation between Bangladesh and Sri Lanka decreased by 0.13 per cent. These changes in correlation show the volatile relationship among the equity markets of the four countries in the region. The low return correlations between the South Asian markets suggest that portfolio investment within this region may offer large diversification benefits. However, correlation analysis provides a static measure of the relationships between the markets and the sub-period analysis suggests that a dynamic measure may be more appropriate[129]. Therefore, it was decided to undertake cointegration analysis along with Granger causality tests, impulse response function analysis and variance decomposition analysis.

[129] Alexander (2001) suggested that cointegration is a much better method than the calculation of correlation coefficients due to the loss of the long-term relations between the series in correlation analysis.

**Table 5.4: Correlation Coefficients of the Weekly Stock Return Series**

| Market | Bangladesh | India | Pakistan | Sri Lanka |
|---|---|---|---|---|
| **Panel A: Entire Period (05-01-1993 to 28-12-2010)** | | | | |
| **Bangladesh** | 1 | | | |
| **India** | -0.0038 | 1 | | |
| **Pakistan** | 0.0177 | 0.1491 | 1 | |
| **Sri Lanka** | 0.0059 | 0.1316 | 0.1058 | 1 |
| **Panel B: First Sub-Period (05-01-1993 to 26-06-2001)** | | | | |
| **Bangladesh** | 1 | | | |
| **India** | -0.0689 | 1 | | |
| **Pakistan** | 0.0052 | 0.1294 | 1 | |
| **Sri Lanka** | 0.0094 | 0.1035 | 0.1899 | 1 |
| **Panel C: Second Sub-Period (01-01-2002 to 28-12-2010)** | | | | |
| **Bangladesh** | 1 | | | |
| **India** | 0.0745 | 1 | | |
| **Pakistan** | 0.0359 | 0.1505 | 1 | |
| **Sri Lanka** | 0.0081 | 0.1350 | -0.0212 | 1 |
| **Panel D: Percentage Difference over the Two Sub-Periods** | | | | |
| **Bangladesh** | -- | | | |
| **India** | 14.34 | -- | | |
| **Pakistan** | 3.07 | 2.11 | -- | |
| **Sri Lanka** | -0.13 | 3.15 | -21.11 | -- |

The table reports Pearson correlation coefficients for the weekly return series of the four markets. Panel A indicates the correlation coefficients for the entire period while Panels B and C show the values for the two sub-periods. Panel D shows the percentage increase (decrease) in correlations over the two sub-periods.

## 5.3: Stationarity Test Results

Following the procedure adopted by Gilmore and McManus (2002), the least restrictive model which include both constant and trend terms are used. Across all four markets for the entire period, the constant and trend terms were insignificant and hence these were dropped when selecting the appropriate models. However, in the first sub-period, the constant was significant at the five per cent level for all four markets; therefore, the model used for this sub-period included a constant term. In the second sub-period, neither the constant or trend terms were significant for the four markets; these terms were excluded when identifying the appropriate models to employ.

The ADF test was performed using equation (4.1)[130], while the P-P test was estimated using equation (4.2).

The results for the tests on the price indices and their first differences are reported in Table 5.5. Panel A shows results for the entire period whereas Panels B and C show results for the two sub-periods, respectively. The table also supplies results for each index series in both level and first differences. An analysis of this table shows that both the ADF and P-P tests confirm that the series were stationary in first differences but non-stationary in levels. For example, over the whole period the ADF test statistics for difference series ranged from -15.079 for India to -17.472 for Pakistan. Since the critical value at the five per cent level was only -1.941, the null hypothesis of non-stationarity is rejected in first difference. For the P-P test, the statistics from the first differences of the series were even larger, ranging from -28.322 for Sri Lanka to -32.837 for India. The remaining panels of Table 5.5 indicate that the level series were non-stationary; the equity indices were integrated of order one, I(1), in all three time periods. For example, in the first sub-period the ADF test statistics were all greater than -1.102 for Bangladesh. In the second sub-period this failure to reject the null is even stronger since the ADF and P-P statistics for all four equity indices were positive.

The KPSS test for unit roots is often used to supplement the ADF and P-P statistics tests. According to Kwiatkowski, Phillips, Schmidt, and Shin (1992), in the ADF test, the existence of a unit root is the null hypothesis. In classical hypothesis testing, the null is accepted unless there is strong evidence against it. Thus, the ADF test is not considered to be very powerful against relevant alternatives. The P-P test for unit roots suffers from the same limitation. In contrast, the KPSS test for unit roots is based on the null hypothesis that a series is stationary around a level. The last two columns of Table 5.5 show results of the KPSS test for the entire sample period as

[130] The appropriate lag length for the ADF test was determined by minimising Schwarz's Information Criteria (SIC); this was used consistently for all markets as well as for the three sample periods to provide an appropriate lag lengths for the ADF.

well as for the two sub-periods. The null hypothesis of stationarity is rejected in levels where the test statistic values are greater than the critical values at the five per cent level. The final column shows that all index series are stationary in their first difference forms where the null hypothesis of stationarity is not rejected for the KPSS test. Thus the results for the KPSS test support the ADF and P-P findings in that the series are non-stationary in their level form; whereas they are all stationary in their first differenced form. These results are further supported by Figures 5.1 to 5.4 and 5.5 to 5.8, which show the data in its level and first differenced form, respectively, for the entire sample period only[131]. Thus, conditions for using cointegration analysis are fulfilled since all equity series are stationary in first differences and integrated to the same order. The OLS regression is inappropriate for analysing long-run relationships among the four markets due to the spurious results which it would yield. Consequently, the cointegration approach is employed instead for investigating the long-run relationships among the four emerging markets of South Asia.

[131] As reported earlier, the stock market in Bangladesh suffered from internal issues in the late 1990s. As a consequence of these issues, the period of 1997-2004 was considered as the period of regulations and reforms (Hussain, 2006). As a result, the investors lost their confidence in the market. According to the report of the Independent Review of Bangladesh's Development: "The recovery of the capital market remain painfully slow since the boom and bust episodes of 1996. During the period January-September 2002, the weighted average share price index of the Dhaka Stock Exchange (DSE) increased by only 0.5 per cent" (p.15). This is evident from Figure 5.1 which indicates that during this time period the stock market of Bangladesh was almost constant, with minimal changes in share prices.

**Table 5.5: Unit Root Test Results for Entire Period and for Two Sub-Periods**

**Panel A: Test Results for the Entire Period, 05/01/1993 to 28/12/2010**

| | **ADF** | | **P-P** | | **KPSS** | |
|---|---|---|---|---|---|---|
| **Country** | **Level** | **1st Diff:** | **Level** | **1st Diff:** | **Level** | **1st Diff:** |
| **Bangladesh** | 3.419 | -16.970* | 3.647 | -29.755* | 2.003* | 0.655 |
| **India** | 1.051 | -15.079* | 1.291 | -32.837* | 2.906* | 0.215 |
| **Pakistan** | 0.520 | -17.472* | 0.678 | -28.676* | 2.945* | 0.133 |
| **Sri Lanka** | 3.458 | -16.562* | 3.396 | -28.322* | 2.641* | 0.409 |

**Panel B: Test Results for Sub-Period 1, 05/01/1993 to 26/06/2001**

| | **ADF** | | **P-P** | | **KPSS** | |
|---|---|---|---|---|---|---|
| **Country** | **Level** | **1st Diff:** | **Level** | **1st Diff:** | **Level** | **1st Diff:** |
| **Bangladesh** | -1.102 | -12.491* | -1.044 | -21.639* | 0.333 | 0.063 |
| **India** | -0.459 | -12.684* | -0.420 | -22.614* | 0.521* | 0.065 |
| **Pakistan** | -0.371 | -19.261* | -0.428 | -19.320* | 0.604* | 0.092 |
| **Sri Lanka** | -0.525 | -15.998* | -0.516 | -16.039* | 0.884* | 0.153 |

**Panel C: Test Results for Sub-Period 2, 01/01/2002 to 28/12/2010**

| | **ADF** | | **P-P** | | **KPSS** | |
|---|---|---|---|---|---|---|
| **Country** | **Level** | **1st Diff:** | **Level** | **1st Diff:** | **Level** | **1st Diff:** |
| **Bangladesh** | 5.006 | -10.877* | 5.040 | -17.765* | 1.888* | 0.218 |
| **India** | 1.064 | -10.577* | 0.990 | -23.203* | 2.305* | 0.053 |
| **Pakistan** | 0.392 | -12.273* | 0.559 | -20.009* | 1.740* | 0.148 |
| **Sri Lanka** | 2.818 | -11.442* | 2.843 | -20.140* | 1.643* | 0.429 |

The table shows unit root test results using the ADF, the P-P and the KPSS tests. Panel A indicted results for the entire period whereas Panels B and C show the results for sub-periods 1 and 2, respectively. The critical values are -2.5674 at 1 per cent level and -1.9412 at 5 per cent level for the ADF and P-P tests and are based on MacKinnon (1996). For the KPSS the critical value is 0.463 at the five per cent level (KPSS, 1992). An * indicate that the values are significant at the five per cent level and the P-values are less than 0.05.

**Figure 5.1: Bangladesh Price Series[132]**

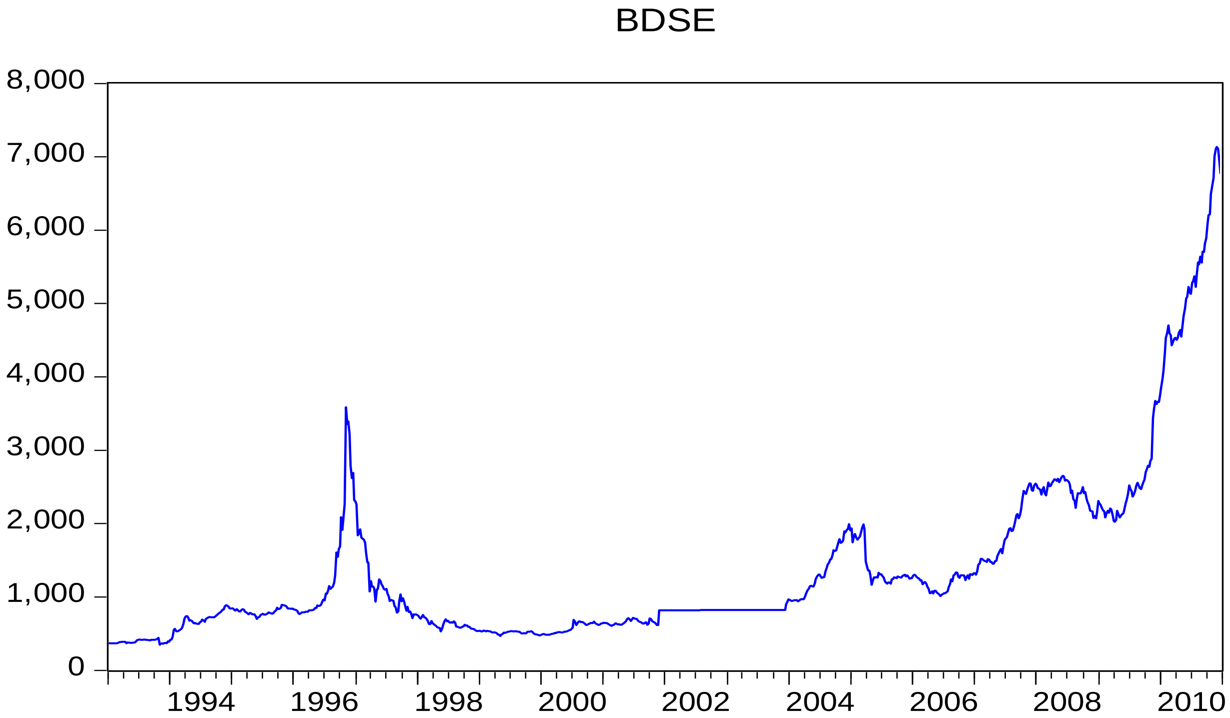
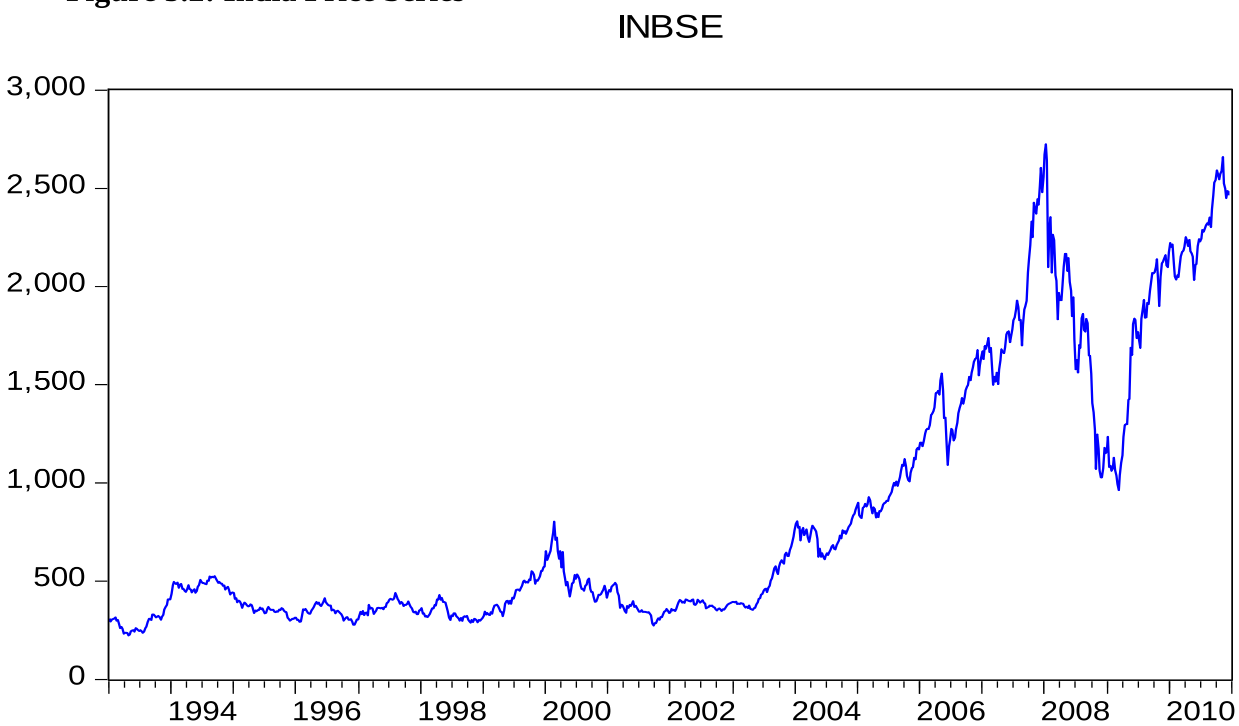



**Figure 5.2: India Price Series**




132 Despite what might appear from a visual inspection of Figure 5.1, there was no structural break in the Bangladeshi series. Actually the Bangladeshi series showed very small changes which are not visible in the graph due to the scale employed. These small changes were due to the reforms which were introduced during the period. Explanations of these reforms are provided in Chapter 2 of the thesis.

**Figure 5.3: Pakistan Price Series**

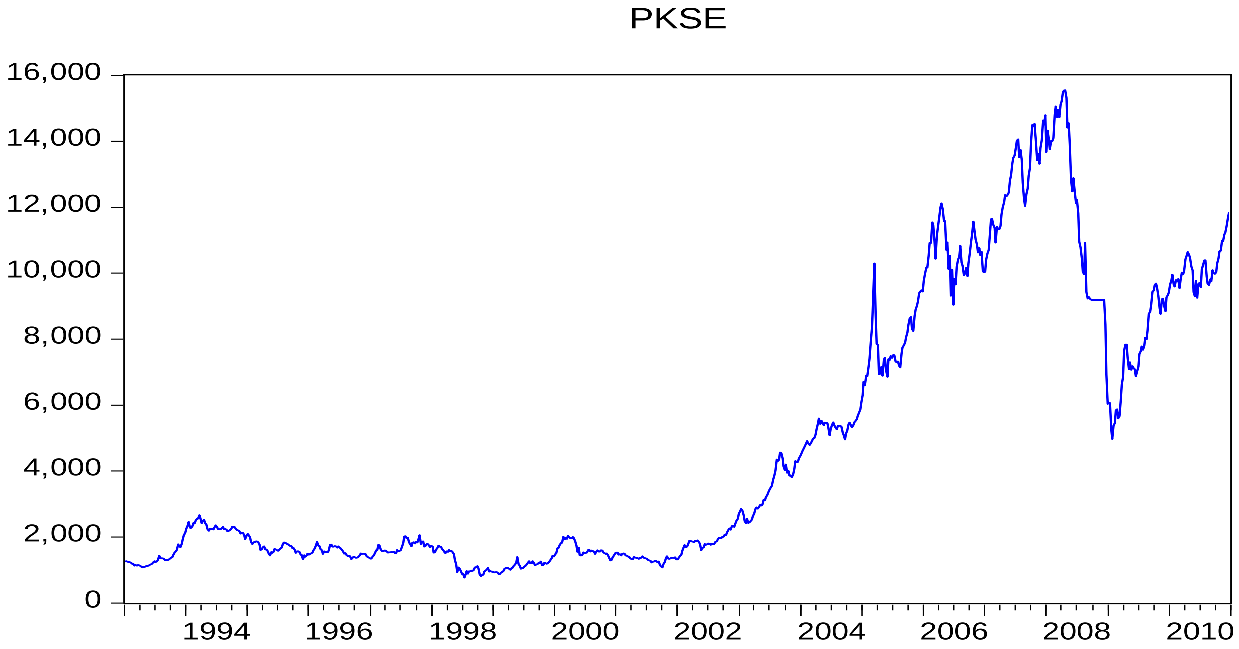
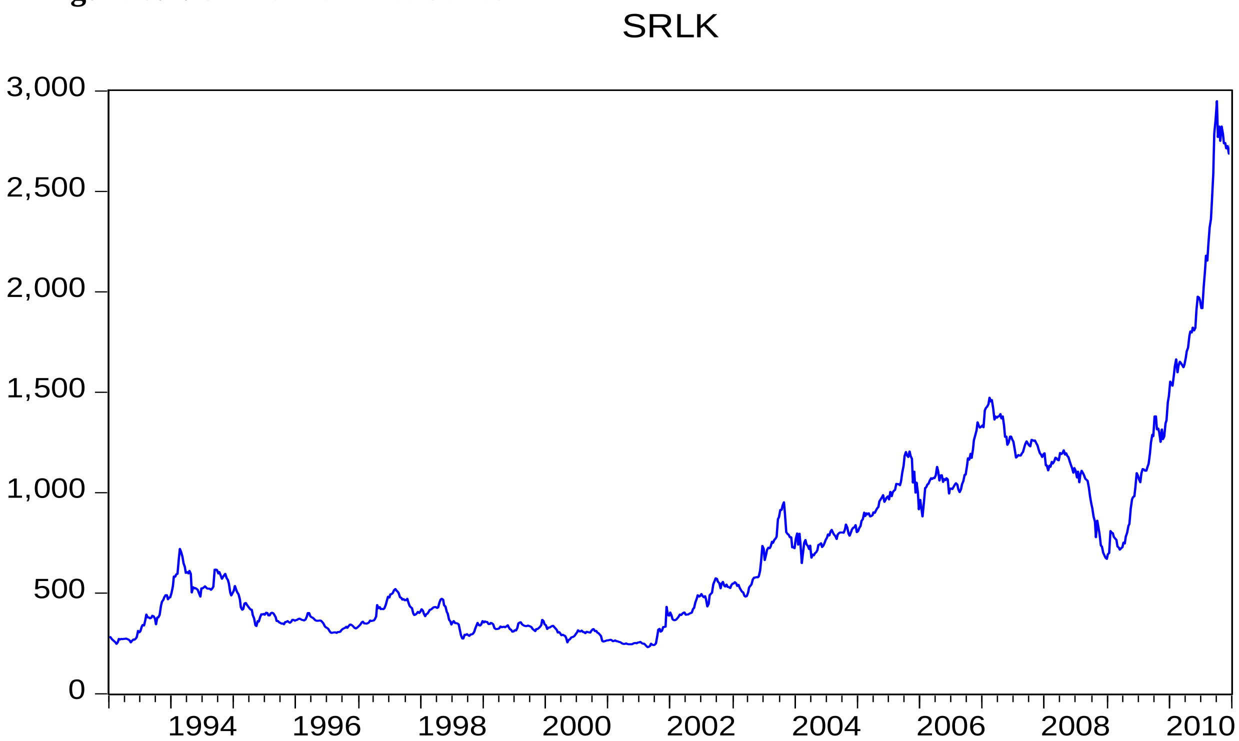



**Figure 5.4: Sri Lanka Price Series**




Figures. 5.1-5.4. Stock price indices during January 1993 and December 2010. The stock indices of BDSE, INBSE, PKSE and SRLK correspond, respectively, to the stock markets of Bangladesh, India, Pakistan and Sri Lanka.

**Figure 5.5: Bangladesh First Differenced Series**

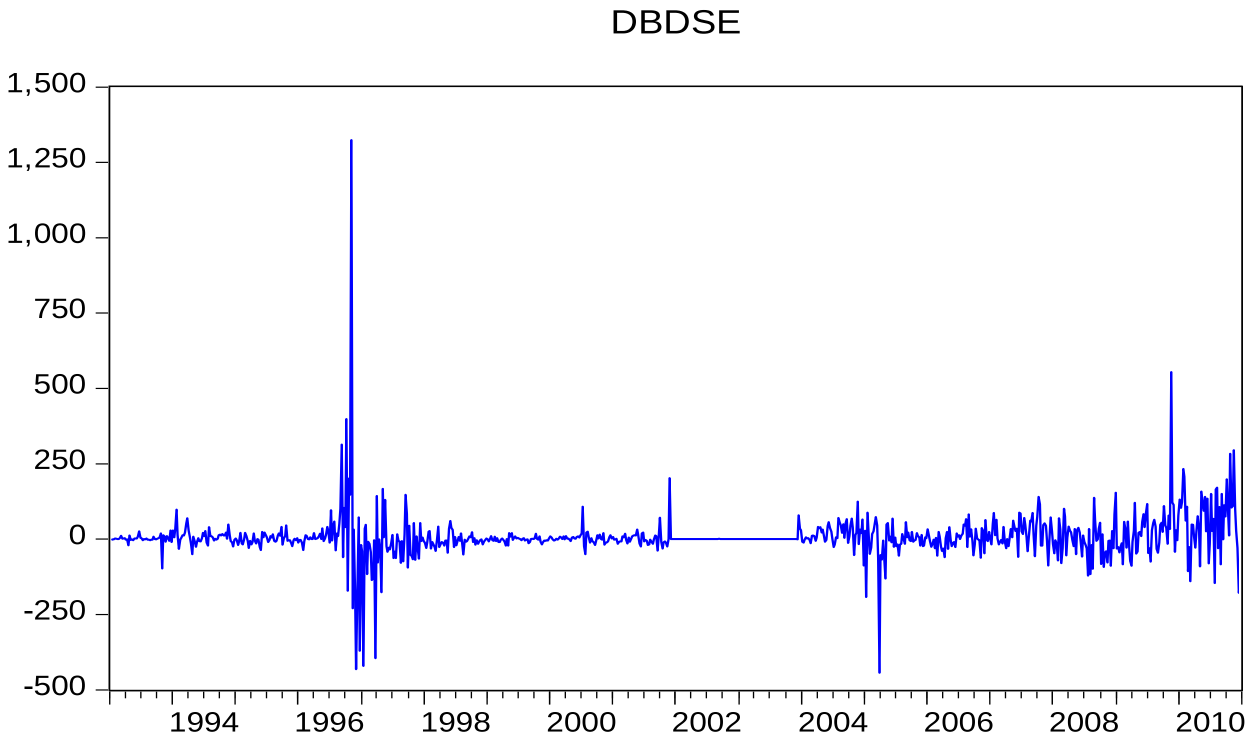



**Figure 5.6: India First Differenced Series**

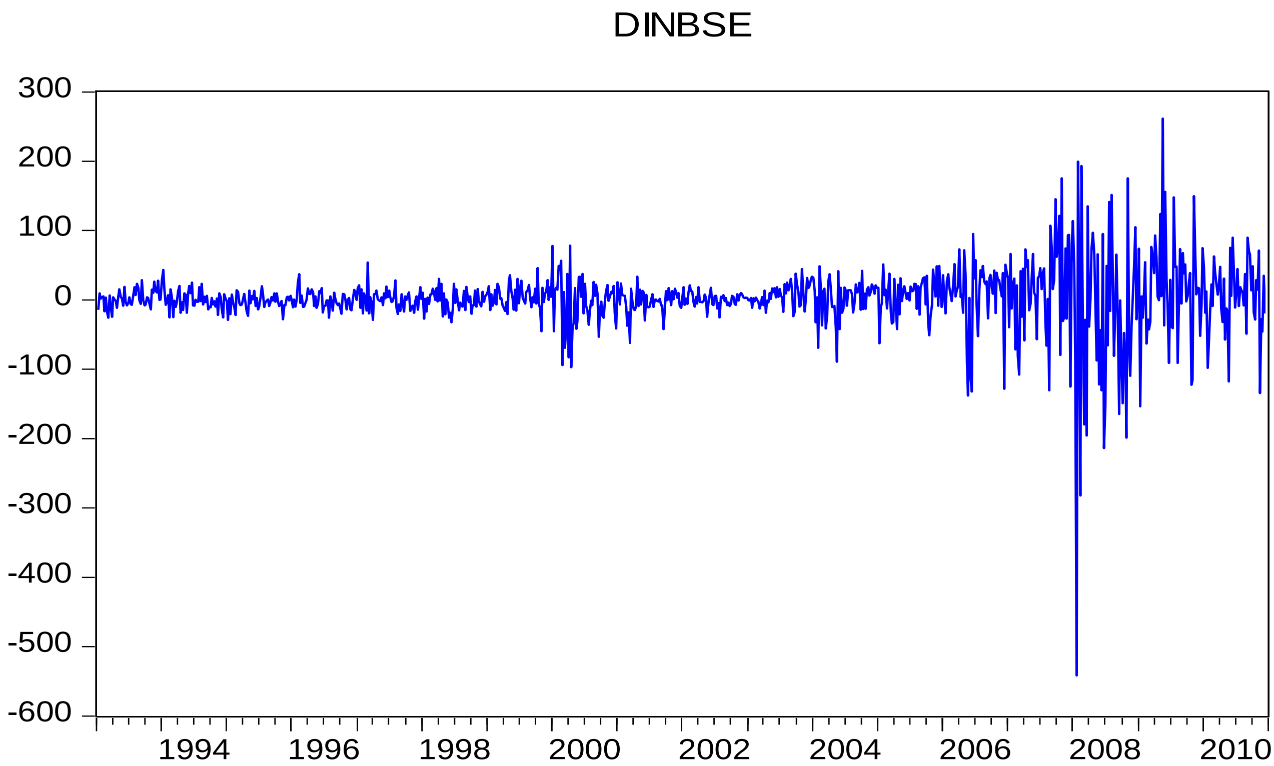


**Figure 5.7: Pakistan First Differenced Series**

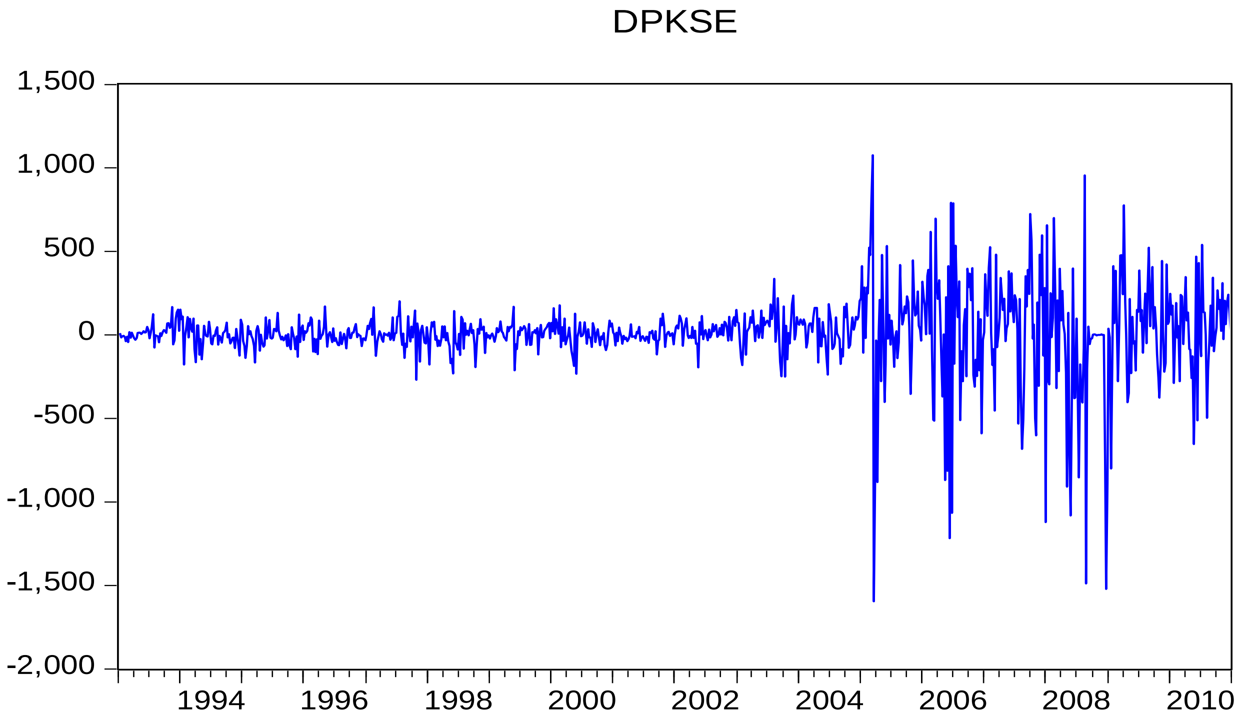
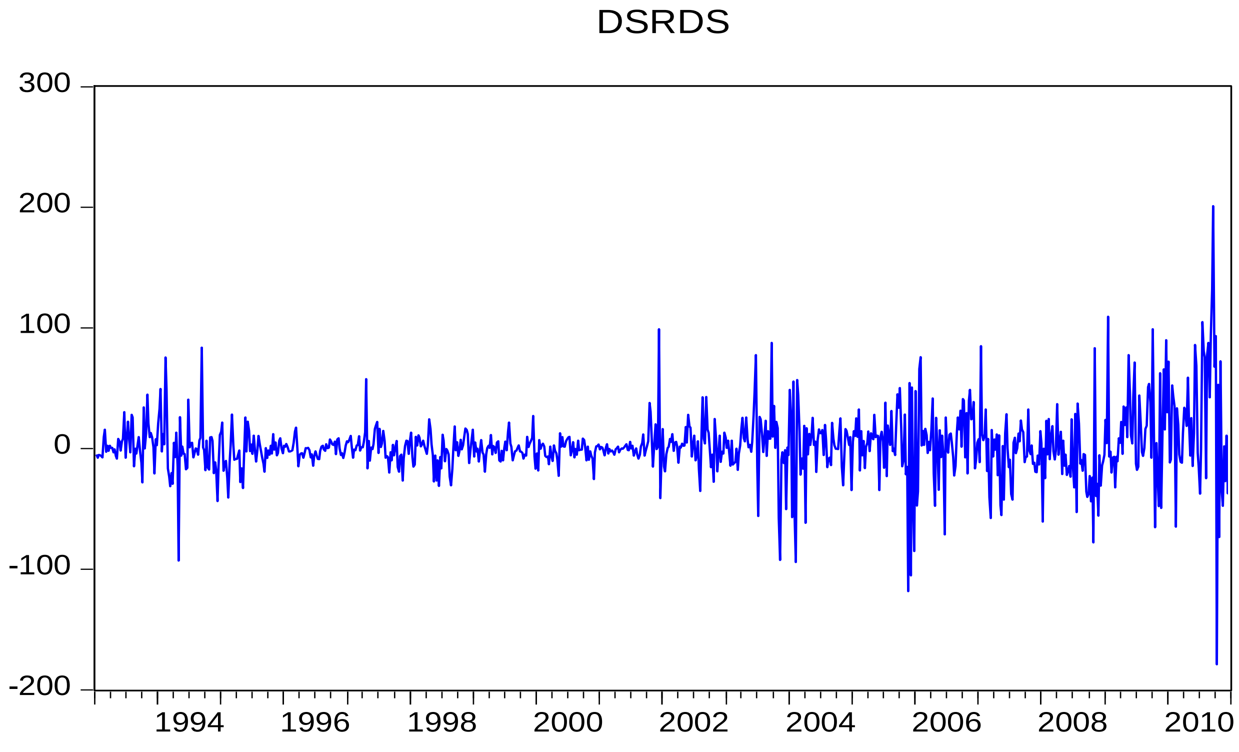



**Figure 5.8: Sri Lanka First Differenced Series**



## 5.4: Cointegration Analysis

A decision was taken in this thesis to use Johansen's multivariate cointegration analysis to investigate the interdependence among the four South Asian markets[133]. If the four stock markets share a common trend, then the gains from diversifying into this region may be reduced. In addition, the existence of a cointegrating vector would suggest that the markets are not weak form efficient since the VECM would indicate that returns in one market can be used to predict price changes in another (MacDonald and Power, 1994). All the four countries were considered as a system over the entire period from January 1993 to 2010 and for the two sub-periods from January 1993 to June 2001 and from January 2002 to December 2010, in order to investigate the impact of September 11th 2001 on the level of integration of these four emerging markets. The study investigates how the four markets are integrated with each other over various time periods and thus, have implications for investors investing in this region.

To estimate equation (4.3), an appropriate lag length must be determined. The order of the lag length selected is reported in Table 5.6. This was determined using both the Schwarz Information Criteria (SIC) and Akaike Information Criteria (AIC) for the entire period and for the two sub-periods[134]. Using 10 lags in the general VAR model, the objective is to choose the number of parameters which minimise the value of the information criteria. Both these criteria are used for selecting optimal lag lengths by choosing the model with the minimum SIC or AIC (Brooks, 2008). Since the SIC has a tendency to underestimate the lag order, it is more appropriate than the AIC when the sample size is large. Adding more lags increases the penalty for the loss of degrees of freedom imposed by the SIC and AIC. A

[133] Details of the cointegration method are provided in Chapter 4.
[134] An information criterion takes into account the Residual Sum of Squares (RSS) and penalty term for the loss of degrees of freedom due to the addition of more parameters. SIC includes a stiffer penalty term than AIC. In addition, AIC is more efficient than the SIC (Brooks, 2008), and therefore AIC is used in this thesis.

comparison of the two information criteria shows that the AIC has its smallest value for the entire period at lag four while the SIC achieves its minimum value at lag two (44.9172 vs. 45.0883); therefore, the AIC is used to select the lag length of four weeks since the statistic is lower than it's SIC counterpart. For the two sub-periods a smaller number of lags are needed. Specifically, in the first and second sub-periods only three lags is needed according to the AIC which documented minimum values of 39.6827 and 46.4175, respectively.

**Table 5.6: Order of Lag Length Selection**

| | Entire Period | | Sub-Period 1 | | Sub-Period 2 | |
|---|---|---|---|---|---|---|
| Lag | AIC | SIC | AIC | SIC | AIC | SIC |
| 0 | 62.2989 | 62.3197 | 52.2780 | 52.3156 | 63.1712 | 63.2072 |
| 1 | 44.9842 | 45.0883* | 39.7656 | 39.9536* | 46.4332 | 46.6128* |
| 2 | 44.9672 | 45.1545 | 39.7177 | 40.0562 | 46.4179 | 46.7412 |
| 3 | 44.9241 | 45.1947 | 39.6827* | 40.1716 | 46.4175* | 46.8845 |
| 4 | 44.9172* | 45.2710 | 39.7386 | 40.3780 | 46.4275 | 47.0382 |
| 5 | 44.9240 | 45.3611 | 39.7646 | 40.5543 | 46.4569 | 47.2113 |
| 6 | 44.9234 | 45.4437 | 39.7936 | 40.7337 | 46.4792 | 47.3772 |
| 7 | 44.9257 | 45.5293 | 39.8009 | 40.8914 | 46.4945 | 47.5362 |
| 8 | 44.9253 | 45.6122 | 39.8395 | 41.0805 | 46.4943 | 47.6797 |
| 9 | 44.9296 | 45.6997 | 39.8890 | 41.2804 | 46.5224 | 47.8515 |
| 10 | 44.9318 | 45.7852 | 39.9305 | 41.4723 | 46.5524 | 48.0253 |

* indicates lag order selected by the criteria. AIC is Akaike Information Criteria, and SIC is Schwarz Information Criteria.

Having selected the appropriate lag length based on the AIC for the whole period as well as the two sub-periods, the appropriate model was then determined; the researcher decided on whether or not to include a deterministic trend and an intercept term in the model. For the entire period, the model with an intercept and no deterministic trend was selected using the AIC criterion. For sub-periods 1 and 2, the specified models had an intercept but no trend term. The cointegration analysis based on the selected models was then performed; the $\lambda_{trace}$ test and $\lambda_{max}$ eigenvalues test statistics are reported in Table 5.7.

**Table 5.7 Multivariate Johansen Cointegration Test Results**

| Rank | Trace Test | Critical Value | p-Value | Max Test | Critical Values | p-Value |
|---|---|---|---|---|---|---|
| **Panel A: Entire Period, January 1993 to December 2010** | | | | | | |
| 0 | 82.4418* | 54.0790 | 0.000 | 50.0512* | 28.5881 | 0.000 |
| 1 | 32.3906 | 35.1928 | 0.097 | 19.5021 | 22.2996 | 0.118 |
| 2 | 12.8885 | 20.2618 | 0.373 | 9.2071 | 15.8921 | 0.412 |
| 3 | 3.6814 | 9.1645 | 0.462 | 3.6814 | 9.1645 | 0.462 |
| **Panel B: Sub-Period 1, January 1993 to June 2001** | | | | | | |
| 0 | 36.2778 | 54.0790 | 0.661 | 17.2163 | 28.5881 | 0.643 |
| 1 | 19.0615 | 35.1928 | 0.783 | 9.6462 | 22.2996 | 0.862 |
| 2 | 9.4153 | 20.2618 | 0.697 | 6.4820 | 15.8921 | 0.732 |
| 3 | 2.9333 | 9.1645 | 0.593 | 2.9333 | 9.1645 | 0.593 |
| **Panel C Sub-Period 2, January 2002 to December 2010** | | | | | | |
| 0 | 72.0728* | 40.1749 | 0.000 | 52.1880* | 24.1592 | 0.000 |
| 1 | 19.8849 | 24.2760 | 0.162 | 12.8996 | 17.7973 | 0.234 |
| 2 | 6.9852 | 12.3209 | 0.327 | 5.1258 | 11.2248 | 0.460 |
| 3 | 1.8595 | 4.1299 | 0.203 | 1.8594 | 4.1300 | 0.203 |

Critical values are based on MacKinnon-Haugh-Michelis (1999); * denotes significance of the test statistic at the five per cent level.

Table 5.7 documents the results of the cointegration tests based on the $\lambda_{trace}$ statistic and the $\lambda_{max}$ eigenvalues statistic for the four South Asian countries of Bangladesh, India, Pakistan and Sri Lanka. Panel A reports results for the entire period from January 1993 to December 2010 whereas Panels B and C show results for the two sub-periods from January 1993 to June 2001 and from January 2002 to December 2010, respectively. The first column in this table shows the number of cointegrating vectors investigated while the next three columns report the trace test values, the critical values for this test and the p-value. The final three columns detail the statistics, the critical values and the p-values for the $\lambda_{max}$ test.

A visual inspection of Panel A reveals that the null hypothesis of r = 0 can be rejected since the $\lambda_{trace}$ statistic of 82.4418 for the South Asian countries is greater than its critical value of 54.0790 at the five per cent significance level. The $\lambda_{max}$ test statistic has a value of

50.0512 which is also higher than its critical value of 28.5881 at the five per cent level of significance. Both tests indicate that the markets have one cointegrating vector and three stochastic trends in the entire sample period since we fail to reject the null for values of $r > 0$. Panel B indicates that the $\lambda_{trace}$ and $\lambda_{max}$ test statistic values are lower than the five per cent significance level when the data are restricted from January 1993 to June 2001, suggesting that there was no evidence of cointegration among the markets during this period. Such a finding is not too surprising since Chapter 2 highlighted that some barriers to equity investment may still have been present up until the end of the 1990s; these may have reduced any linkages between the stock markets and dissipated any relationships between equity returns. According to Panel C, the $\lambda_{trace}$ and $\lambda_{max}$ statistics are higher than their critical values at the five per cent level of significance for the null hypothesis of r=0; the null is therefore rejected by both tests and one cointegrating vector is detected during the second sub-period. The values for the test statistic are greater than the corresponding critical value which indicates rejection of the null hypothesis of no cointegration among the stock market indices of the South Asian region over the entire period from January 1993 to December 2010. The markets have a common trend in the long-run which suggests that there may be less diversification benefits for international investors because of their comovement. The results also suggest that integration among the region has increased after the September 11, 2001 attacks on the US. The markets show more linkages after September 2001, which also indicates that global events of importance may have had a common impact on the behaviour of these markets as equity indices plunged. The results may also suggest that the market liberalisation policies highlighted in Chapter 2 have increased portfolio equity flows between the countries and caused shares prices in the region to move together[135].

[135] In order to further analyse cointegration relationships among the four stock indices of the South Asian region, a plot of the cointegrating vector is presented for the entire sample period as well as for the two sub-periods in Appendix 5.1. The presence of one cointegrating vector in the entire sample period and in the second

### 5.4.1: Implications for Portfolio Diversification and Market Efficiency

According to portfolio theory, investors will diversify their investment across national borders when domestic and foreign markets are not perfectly correlated. Starting with Grubel (1968), the benefits from international portfolio diversification in terms of both reduced risk and higher returns are well documented in the literature[136]. Cointegration of markets has important implications for international portfolio diversification. Cointegrated markets would indicate the existence of some common force bringing the markets into equilibrium in the long-run. According to Masih and Masih (1999, 2002) this common force is the arbitrage activities of international investors bringing the markets into equilibrium in the long-run. In other words, cointegration analysis tests the level of arbitrage activities in the long-run. In the case of no cointegration, the results would indicate that the level of arbitrage activity bringing the markets into equilibrium is zero (Masih and Masih, 1999; Narayan et al., 2004).

More recently, Phylaktis and Ravazzolo (2005, p.93) have reported that:

> "If markets are interdependent and driven by common shocks, which have a permanent effect, they will provide limited possibilities of gaining abnormal profits by diversifying investment portfolios since they will be arbitraged away in the long term. If, however, there are persistent deviations from the common trend, then international investors might make short-term speculative investments based on the forecast that the market will revert to its long-term relationship with the world market".

The findings from the cointegration analysis reported in Section 5.3 have practical implications for portfolio diversification and suggest that the chances of making gains in the South Asian region by spreading investment over the equities of four countries are limited in

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sub-period is evident from Figures 5.1 and 5.3 in Appendix 5.1. These figure indicates that the system converge to equilibrium (the deviations from the long-run relationships are eventually corrected) soon after some deviations. By contrast, Figure 5.2 indicates higher deviations from the equilibrium with slow convergence to the long-run equilibrium position.

[136] For a more detailed commentary on this issue see Chapter 3.

the long-run. When the markets are cointegrated, such diversification returns will be arbitraged away in the long-run. However, Masih and Masih (1999), argue that any findings of cointegration should be interpreted with care. They proposed two caveats to the statement that cointegration implies limited opportunities for portfolio diversification. First, cointegration does not abolish the possibility for making arbitrage profits by portfolio diversification in these markets in the short-run; they also point out that the short-run may last for a significant period of time. Second, due to various financial risks associated with different securities, and because the covariance between cash flows from different securities is less than perfect across countries, the long-run benefits may be limited but are very unlikely to be eliminated in practice.

The markets showed a single cointegrating vector for the entire period (1993 to 2010) and for the second sub-period (2002 to 2010). The presence of this cointegration may therefore limit the benefits from portfolio diversification in the region in the long-run. In addition, the findings suggest that the integration of the markets has increased over time. In the first sub-period, the markets showed no evidence of a cointegrating vector whereas a single cointegrating vector was documented in the second sub-period. This suggests that integration among the four markets has increased in the post September 11, 2001 period. Since September 11, 2001, sufficient time has elapsed to investigate the long-run effect of this event on the integration of the four South Asian markets of Bangladesh, India, Pakistan and Sri Lanka[137].

In the literature, evidence on the existence of cointegration has generated mixed implications for the EMH. Granger (1986) argued that if two prices are cointegrated, it violates one of the

[137] The finding is in agreement with previous studies which have argued that integration among the markets increased as a result of events of global importance. For example, Meric et al. (2008) found significant comovement among eight markets after the September 11, 2001 US attacks. The eight markets studied were that of Australia, China, India, Japan, Korea, Russia, the UK and the US using weekly index data over a period from September 1996 to September 2006. They conducted correlation analysis, PCA and Granger Causality tests.

central tenants of the EMH. MacDonald and Power (1994), Chan et al. (1997), Liu et al. (1997), Yuhn (1997), Huang et al. (2000), Leopodis (2004) and Diamandis (2009) have highlighted that if asset prices in various markets are cointegrated, this violates the weak form of the EMH because price changes in one market will be significantly influenced by lagged price changes in another market over the short-run; these lagged price changes may be used to predict current price changes in the first market.

By contrast, Masih and Masih (1999, 2002) and Narayan et al. (2004) have argued that cointegration does not necessarily indicate that markets are inefficient. They suggested that markets would only be inefficient if any predictability resulted in risk-adjusted excess returns[138]. According to Masih and Masih (2002, p.87),

> "A market is inefficient only if by using the predictability one could earn risk-adjusted excess returns. If returns could be generated, are they just compensation for risks or are truly excess and risk-adjusted? Therefore, one should be very careful in concluding that cointegration or a lack thereof necessarily implies anything about market inefficiency or efficiency".

Therefore, the current thesis employed a mix of econometric techniques along with the cointegration analysis to investigate weak form market efficiency in the South Asian region.

### 5.5: The Vector Error Correction Model (VECM)

The multivariate Johansen cointegration test results reported in Table 5.7 indicate one cointegrating vector for both the entire period and for sub-period 2. Both $\lambda_{trace}$ and $\lambda_{max}$ tests confirm that a long-run relationship exists among these four markets – especially since 2001. The cointegration results in Table 5.7 indicate that the four markets have a tendency to

[138] The mixed evidence on this issue is discussed in more detail in Chapter 3.

comove in the long-run. However, in the short-run, they may deviate from this long-run relationship. To further investigate the relationships among the four equity markets of South Asia, the VECM is examined[139]. The intuition behind the VECM analysis is that, when the markets are in equilibrium, part of the current changes in one market affects the tendency to respond to trends in the other countries being examined. The VECM is used to examine the short- and long-run relationships among the four markets for the entire period and for the second sub-period.

The VECM results for the entire period are reported in Table 5.8. The four panels of Table 5.8 show results for each market in the system[140]. The bottom of each panel indicates whether or not the Error Correction Term (ECT) is significant at the five per cent level of significance. The top of each panel reports the short-run impact for a market of both lagged changes in its own values as well as lagged and current changes in the other three markets. An inspection of Panel A indicates that adjustment to a long-run relationship is present between the Bangladeshi market and the other three markets of India, Pakistan and Sri Lanka. The ECT value of -0.0127 is less than the critical value of -5.2320. An analysis of the first part of Panel A highlights the short-run dynamics behind this long-run relationship. The statistics in the first part of Panel A reveal that the Bangladeshi market tends to be influenced by lagged values of its own performance. The t-statistics for each of the lagged changes in the indices of India, Pakistan and Sri Lanka show that changes in the Bangladeshi market are not influenced by variations in these three markets over the previous weeks; however, its own lagged values in the second week are significant.

The findings for India in the second panel indicate that the ECT is not significant which suggests that no long-run relationship exists between the Indian market and the other three

[139] The appropriate VECM model associated with the cointegration analysis was analysed with the same restrictions imposed as the cointegration system.
[140] The lag selection is based on the AIC information criteria in Table 5.6.

markets in the analysis. This indicates that the Indian market is exogenous in the system of the four markets over the long-run. The t-statistic value for the lagged changes in the indices of Bangladesh, Pakistan and Sri Lanka shows that changes in the Indian market are influenced in the short-run by changes in the Pakistani and the Sri Lankan market and its own lagged values in previous weeks.

Panel C of Table 5.8 reports the VECM results when Pakistan is the dependent market. It shows that a long-run relationship exists between Pakistan and Bangladesh, India and Sri Lanka. The ECT value of -0.0289 is significant at the five per cent level of significance. A visual inspection of the individual t-statistic values reveals that in the long-run changes in the three markets has a significant effect on changes in Pakistan. In particular, lagged changes in the equity index for India have a significant effect on the Pakistani market along with its own lagged values. The last panel of Table 5.8 shows results from the VECM for the Sri Lankan market. The error correction term is statistically significant indicating a long-run relationship between the Sri Lankan market and the other three South Asian markets. An analysis of the individual t-statistic values for the lagged changes indicates that contemporaneous changes in the Sri Lankan market are affected by changes in the Pakistani market and changes in the lagged values of its own index in previous weeks.

Overall, the results of the VECM for the four South Asian markets indicate that the three stock markets of Bangladesh, Pakistan and Sri Lanka move from disequilibrium in the price system in a fairly rapid fashion; from Table 5.8, it is evident that these three markets have significant t-statistic values for the ECT. The coefficient value on the significant ECT also indicates a relatively high speed of adjustment towards long-run equilibrium in the Bangladeshi market as compared with the Pakistani and Sri Lankan markets. In addition, these results confirm the cointegration results in Table 5.7 about the existence of the long-run relationship amongst the markets. In sub-period 1, the cointegration tests indicated no equilibrium in the long-run and hence no cointegrating vector in the four markets. Therefore, the VECM results for this sub-period are not reported. In sub-period 2, the markets show one cointegrating vector and therefore, the VECM results are reported in Table 5.9. The results for sub-period 2 are similar to the findings for the entire period with the markets of Bangladesh, Pakistan and Sri Lanka showing a significant ECT. The Indian market is the most exogenous (independent) of the four markets considered. An analysis of the individual t-statistic values for the lagged index changes in the Bangladeshi, Indian, Pakistani and Sri Lankan markets indicates that contemporaneous changes in the Bangladeshi market are affected by changes in its own lagged values and changes in lagged values of the Pakistani market. Changes in the Pakistani and Sri Lankan markets are affected by their own lagged values from previous weeks. Contemporaneous changes in the Indian market are affected by changes in its own lagged values and changes in the Pakistani market in previous weeks. The burden of any adjustment to the long-run equilibrium falls on the three relatively small markets in the region.

The results indicate that one cointegrating vector is present for the entire period and for the second sub-period. This finding implies that there are three common stochastic trends; thus, although the markets have move together in the long-run they are not perfectly integrated and hence short-run benefits from diversification may be available. In the first sub-period there is no long-run relationship between the markets, indicating that there were diversification benefits for investors in both the long-run and the short-run during that time period. In addition, the results from the VECM indicate that the burden of any adjustment towards the long-run equilibrium falls on the three relatively smaller markets of Bangladesh, Pakistan and Sri Lanka; the Indian market being the largest in the region is exogenous throughout the entire sample period, whereas, Pakistan became more influential in the second sub-period (post 9/11).

**Table 5.8: Vector Error Correction Model Results**

**Entire Sample Period, January 1993 to December 2010**

| | Dependent Market | Independent Markets | | |
|---|---|---|---|---|
| **Lag order (Weeks)** | **ΔBDSE** | **ΔINBSE** | **ΔPKSE** | **ΔSRLK** |
| 1 | 0.0410 | 0.0464 | 0.0194 | -0.0747 |
| | (1.2560) | (0.8490) | (1.8009) | (-0.7868) |
| 2 | 0.1546* | 0.0134 | -0.0034 | 0.0123 |
| | (4.7149) | (0.2475) | (-0.3188) | (0.1288) |
| 3 | -0.0188 | -0.0235 | -0.0025 | 0.0650 |
| | (-05685) | (-0.4322) | (-0.2265) | (0.6770) |
| 4 | 0.0197 | 0.0213 | 0.0019 | 0.0286 |
| | (0.6015) | (0.3918) | (0.1725) | (0.2991) |
| | ECT -0.0127* | | | |
| | (-5.2320) | | | |
| | **ΔINBSE** | **ΔBDSE** | **ΔPKSE** | **ΔSRLK** |
| 1 | -0.0889* | -0.0089 | 0.0109 | 0.1104 |
| | (-2.6321) | (-0.4392) | (1.6338) | (1.8816) |
| 2 | 0.0165 | 0.0034 | -0.0038 | 0.1191* |
| | (0.4927) | (0.1653) | (-0.5710) | (2.0188) |
| 3 | 0.1268* | -0.0032 | 0.0234* | -0.0265 |
| | (3.7780) | (-0.1569) | (3.4965) | (-0.4470) |
| 4 | -0.0546 | -0.0176 | 0.0071 | -0.0173 |
| | (-1.6267) | (-0.8675) | (1.0577) | (-0.2922) |
| | ECT 0.0004 | | | |
| | (0.2651) | | | |
| | **ΔPKSE** | **ΔBDSE** | **ΔINBSE** | **ΔSRLK** |
| 1 | 0.0503 | 0.0171 | 0.2682 | 0.2770 |
| | (1.5233) | (0.1712) | (1.5998) | (0.9521) |
| 2 | 0.1639* | 0.0157 | 0.0515 | 0.0403 |
| | (4.9462) | (0.1559) | (0.3099) | (0.1377) |
| 3 | 0.0242 | -0.0233 | -0.2144 | -0.3194 |
| | (0.7290) | (-0.2311) | (-1.2885) | (-1.0848) |
| 4 | 0.0323 | -0.0298 | -0.4169* | -0.1828 |
| | (0.9744) | (-0.2970) | (-2.5046) | (-0.6228) |
| | ECT -0.0289* | | | |
| | (-3.8832) | | | |
| | **ΔSRLK** | **ΔBDSE** | **ΔINBSE** | **ΔPKSE** |
| 1 | 0.0910* | -0.0077 | 0.0367 | 0.0040 |
| | (2.7081) | (-0.6616) | (1.8973) | (1.0560) |
| 2 | 0.1413* | 0.0064 | 0.0138 | 0.0017 |
| | (4.1815) | (0.5506) | (0.7199) | (0.4311) |
| 3 | 0.0006 | 0.0079 | 0.0120 | 0.0048 |
| | (0.0178) | (0.6794) | (0.6242) | (1.2394) |
| 4 | 0.0068 | 0.0033 | 0.0265 | -0.0130* |
| | (0.2005) | (0.2829) | (1.3794) | (-3.3901) |
| | ECT -0.0020* | | | |
| | (-2.2958) | | | |

The error correction term (ECT) for Bangladesh, India, Pakistan and Sri Lanka is derived by normalising on the cointegrating vector for that specific market. Figures in parenthesis show the t-statistic which tests the null that the ECT is statistically insignificant. Values with an * shows significance at the five per cent level.

**Table 5.9: Vector Error Correction Model Results**

| | **Sub-Period 2, January 2002 to December 2010** | | | |
|---|---|---|---|---|
| | Dependent Market | Independent Markets | | |
| **Lag order (Weeks)** | **ΔBDSE** | **ΔINBSE** | **ΔPKSE** | **ΔSRLK** |
| 1 | 0.1601* | 0.0413 | 0.0215* | -0.0575 |
| | (3.4555) | (0.8919) | (2.3802) | (-0.6744) |
| 2 | 0.0969* | -0.0073 | -0.0066 | -0.0062 |
| | (2.0580) | (-0.1556) | (-0.7331) | (-0.0725) |
| 3 | -0.0851 | -0.0150 | 0.0015 | 0.0968 |
| | (-1.8170) | (-0.3269) | (0.1699) | (1.1243) |
| | ECT -0.0135* | | | |
| | (-5.7527) | | | |
| | **ΔINBSE** | **ΔBDSE** | **ΔPKSE** | **ΔSRLK** |
| 1 | -0.0872 | -0.0233 | 0.0113 | 0.1339 |
| | (-1.8352) | (-0.4893) | (1.2150) | (1.5279) |
| 2 | 0.0049 | 0.0189 | -0.0038 | 0.1524 |
| | (0.1024) | (0.3907) | (-0.4132) | (1.7465) |
| 3 | 0.1504* | 0.0094 | 0.0220* | -0.0413 |
| | (3.1813) | (0.1952) | (2.3635) | (-0.4674) |
| | ECT 0.0017 | | | |
| | (0.7167) | | | |
| | **ΔPKSE** | **ΔBDSE** | **ΔINBSE** | **ΔSRLK** |
| 1 | 0.0562 | -0.0370 | 0.1898 | 0.2635 |
| | (1.1935) | (-0.1529) | (0.7854) | (0.5909) |
| 2 | 0.1750* | -0.0035 | -0.0163 | -0.0353 |
| | (3.7269) | (-0.0142) | (-0.0670) | (-0.0796) |
| 3 | 0.0190 | -0.0926 | -0.1848 | -0.4550 |
| | (0.4020) | (-0.3784) | (-0.7686) | (-1.0117) |
| | ECT -0.0330* | | | |
| | (-2.6925) | | | |
| | **ΔSRLK** | **ΔBDSE** | **ΔINBSE** | **ΔPKSE** |
| 1 | 0.0623 | -0.0344 | 0.0256 | 0.0032 |
| | (1.2903) | (-1.3132) | (0.9783) | (0.6320) |
| 2 | 0.1548* | 0.0038 | 0.0063 | 0.0005 |
| | (3.2225) | (0.1440) | (0.2390) | (0.1031) |
| 3 | -0.0051 | 0.0095 | 0.0048 | 0.0054 |
| | (-0.1044) | (0.3586) | (0.1846) | (1.0590) |
| | ECT -0.0037* | | | |
| | (-2.8123) | | | |

The error correction term (ECT) for Bangladesh, India, Pakistan and Sri Lanka is derived by normalising the cointegrating vector for that specific market. Figures in parenthesis show the t-statistic which tests the null that the ECT is statistically insignificant. Values with an * indicate significance at the five per cent level.

## 5.6: Granger Causality Tests

To further understand the dynamic relationships between the emerging markets of South Asia, Granger causality tests were conducted because they are based on the bivariate VAR and examine one-to-one relationships among the four markets. The results from the Granger causality tests help in further analysing the influence that each market has on all of the others. These highlight which market or markets play a dominant role in influencing share price changes for other markets the region. The null hypothesis is that the first market does not Granger Cause equity index changes in the second market. The results of the pair-wise Granger causality tests are reported in Table 5.10.

**Table 5.10: Pair-wise Granger Causality Test Results**

**Panel A: Entire Period, January 1993 to December 2010**

| | Bangladesh | India | Pakistan | Sri Lanka |
|---|---|---|---|---|
| Bangladesh | | 0.6135 | 0.1787 | 1.9429 |
| | | (0.5417) | (0.8364) | (0.1439) |
| India | 1.9308 | | 8.6734* | 6.1842* |
| | (0.1456) | | (0.0002) | (0.0022) |
| Pakistan | 0.4662 | 1.9591 | | 3.4526* |
| | (0.6275) | (0.1416) | | (0.0321) |
| Sri Lanka | 0.9939 | 08483 | 2.3176 | |
| | (0.3705) | (0.4285) | (0.0991) | |

**Panel (B) sub-Period 1, January 1993 to June 2001**

| | Bangladesh | India | Pakistan | Sri Lanka |
|---|---|---|---|---|
| Bangladesh | | 0.8225 | 0.4536 | 0.1439 |
| | | (0.4400) | (0.6356) | (0.8661) |
| India | 0.5582 | | 7.7368* | 4.5242* |
| | (0.5727) | | (0.0005) | (0.0114) |
| Pakistan | 0.7518 | 1.9689 | | 2.9194** |
| | (0.4721) | (0.1409) | | (0.0550) |
| Sri Lanka | 1.2386 | 0.6524 | 1.5131 | |
| | (0.2908) | (0.5213) | (0.2214) | |

**Panel C: Sub-Period 2, January 2002 to December 2010**

| | Bangladesh | India | Pakistan | Sri Lanka |
|---|---|---|---|---|
| Bangladesh | | 0.0781 | 0.0822 | 0.5818 |
| | | (0.7801) | (0.7745) | (0.4460) |
| India | 3.4728** | | 3.0836** | 1.0369 |
| | (0.0630) | | (0.0797) | (0.3091) |
| Pakistan | 4.1978* | 2.6068 | | 0.3293 |
| | (0.0410) | (0.1071) | | (0.5664) |
| Sri Lanka | 0.2507 | 0.0996 | 0.7893 | |
| | (0.6168) | (0.7525) | (0.3748) | |

* and ** indicate that the null hypothesis is rejected at the five and ten per cent levels of significance, whereas the values in parenthesis are p-values. The test is based on a VAR model.

Table 5.10 indicates that the returns for a number of markets in the South Asian region Granger cause price changes in other countries. According to the statistics in Panel A, unidirectional causality was found from India to Pakistan and Sri Lanka and from Pakistan to Sri Lanka. This shows that the two relatively larger markets have an influence on the other regional stock markets. As the biggest market in the region, India is the most influential. The Bangladeshi market was found to be relatively independent in the time period examined. These results are in agreement with the VECM findings in the previous Section which indicated that the Bangladeshi market was only influenced by own lagged changes in share prices. The findings indicate that the Indian market significantly influenced the Pakistani and Sri Lankan markets. In the first sub-period significant causality was found from India to Pakistan and from India to Sri Lanka. Causality from Pakistan to Sri Lanka was significant only at the ten per cent level. In the second sub-period only the Bangladeshi market was Granger caused by Pakistani equity changes at the five per cent level of significance. In addition, weak linkages were found between Bangladesh and India and between India and Pakistan where the coefficients were significant at the ten per cent level. India, being the largest market in the region, has a significant effect on the rest of the markets while Pakistan was the second most influential market in the region.

## 5.7: The Analysis of Variance Decomposition

Variance decomposition offers a method for examining VAR system dynamics. It gives the proportion of the movements in the dependent variables which are due to shocks in their own as well as the shocks in other variables in the system. A shock to one market may directly affect that market but it may also be transmitted to the other three markets in the system through the dynamic nature of the VAR. Most of the stock returns variation in one market is explained by own shocks and relatively less in the other markets depending on the exogeneity of the other markets. However, the ordering of the variables in the variance decomposition is important; in the current thesis, all possible orderings were analysed and consistent results were achieved. The results for the variance decomposition were therefore robust to a change in the ordering of the variables.

The VECM results in Section 5.4 provide a dynamic framework to test for temporal causality between the returns from various national equity indices. However, the results of this VECM analysis are based on a within-sample test. In addition, to analysing the magnitude and extent of short-run deviations (in terms of the number of weeks), the Generalised Impulse Response Function (GIRF) analysis and the variance decomposition analysis are employed to examine the returns for the four countries being studied. To analyse the relative strength of the variables in the system and to quantify the magnitude of temporal causality results, an analysis of the variance decomposition is carried out. The results from this decomposition are presented in Table 5.11 for the entire period from January 1993 to December 2010. The results for the same decomposition are presented for the two sub-periods in Tables 5.12 and 5.13, respectively. In particular, the tables provide a decomposition of 1, 5, 10 and 20 week ahead forecast error variances of a stock index in terms of the proportions of one market's return that are explained by each of the other three South Asian markets[141]. At a 20 week horizon, the proportion of domestic stock market index variations that is collectively explained by other South Asian markets ranges from 0.71 per cent and 0.67 per cent for Bangladesh and India, respectively to almost 5.00 per cent for the Sri Lankan and Pakistani markets.

Analysing the results from the variance decomposition will also help gauge the extent to which a market is exogenous (independent) from the rest of the markets in the system. The market which explains most of its own shocks and does not rely on changes in other markets

[141] The time horizon was extended up to 50 weeks but there was no significant difference of explanation from the 20 week horizon.

to explain its variance can be characterised as exogenous (Masih and Masih, 2002). A visual inspection of Table 5.11 reveals that in terms of its own shocks being explained, the Bangladeshi and Indian markets display a certain amount of exogeneity with over 99 per cent of their own variance being explained by past innovations in their own equity indices. Pakistan is the most influential market in explaining the variance of the Indian market's returns. In terms of its relative variance being explained by other markets, Pakistan and Sri Lanka were found to be the most 'open' markets. Almost 5.00 per cent of innovations in the Sri Lankan market are explained by changes in the other three markets with the Indian market being the most influential according to the response function results. The results from the variance decomposition are consistent with the results from the VECM, where the brunt of any short-run adjustment fell primarily on the three markets of Bangladesh, Pakistan and Sri Lanka; India was the most exogenous market. In addition, the results reveal that India is the most influential market in explaining the largest amount of the variance in the other three markets.

The results for the two sub-periods are similar to the findings for the whole period; India and Pakistan are the most influential in terms of their explanation of the variance innovations in the rest of the countries. Surprisingly, Bangladesh seems to be an exogenous, explaining most of its own variance and also having minimal effect on the explanations of the variances for the other markets. This may be due to its small size and the impact of thin trading. As the largest market in the region, India is the most influential in explaining changes in the rest of the markets. Pakistan is the second most influential market and the second largest market in the region in terms of market capitalisation and number of companies listed (see Chapter 2).

**Table 5.11: Variance Decomposition for Entire Period, January 1993- December 2010**

| | Percentage of Forecast Variance Explained by Innovations | | | |
|---|---|---|---|---|
| **Weeks** | **ΔBDSE** | **ΔINBSE** | **ΔPKSE** | **ΔSRLK** |
| **Relative variance in ΔBDSE** | | | | |
| 1 | 100.00 | 0.00 | 0.00 | 0.00 |
| 5 | 99.30 | 0.42 | 0.05 | 0.23 |
| 10 | 99.30 | 0.43 | 0.05 | 0.23 |
| 20 | 99.30 | 0.43 | 0.05 | 0.23 |
| **Relative variance in ΔINBSE** | | | | |
| 1 | 0.00 | 100.00 | 0.00 | 0.00 |
| 5 | 0.14 | 99.33 | 0.40 | 0.13 |
| 10 | 0.14 | 99.32 | 0.40 | 0.13 |
| 20 | 0.14 | 99.32 | 0.40 | 0.13 |
| **Relative variance in ΔPKSE** | | | | |
| 1 | 0.00 | 1.90 | 98.10 | 0.00 |
| 5 | 0.04 | 4.34 | 95.33 | 0.29 |
| 10 | 0.04 | 4.34 | 95.33 | 0.29 |
| 20 | 0.04 | 4.34 | 95.33 | 0.29 |
| **Relative variance in ΔSRLK** | | | | |
| 1 | 0.00 | 1.40 | 0.32 | 98.27 |
| 5 | 0.39 | 3.29 | 0.90 | 95.42 |
| 10 | 0.39 | 3.30 | 0.90 | 95.41 |
| 20 | 0.39 | 3.30 | 0.90 | 95.41 |

Figures in the first column refer to the time horizon (number of weeks). All other values in the table are rounded to two decimal places. The order of the variables was changed but there was no significant difference in the results after such changes. The time horizons were extended up to 50 weeks but the results did not change from those reported above.

**Table 5.12: Variance Decomposition for Sub-Period 1, January 1993- June 2001**

| | Percentage of Forecast Variance Explained by Innovations | | | |
|---|---|---|---|---|
| **Weeks** | **ΔBDSE** | **ΔINBSE** | **ΔPKSE** | **ΔSRLK** |
| **Relative variance in ΔBDSE** | | | | |
| 1 | 100.00 | 0.00 | 0.00 | 0.00 |
| 5 | 98.84 | 0.26 | 0.32 | 0.58 |
| 10 | 98.84 | 0.27 | 0.32 | 0.58 |
| 20 | 98.84 | 0.27 | 0.32 | 0.58 |
| **Relative variance in ΔINBSE** | | | | |
| 1 | 0.48 | 99.52 | 0.00 | 0.00 |
| 5 | 0.96 | 97.90 | 0.88 | 0.25 |
| 10 | 0.96 | 97.90 | 0.89 | 0.25 |
| 20 | 0.96 | 97.90 | 0.89 | 0.25 |
| **Relative variance in ΔPKSE** | | | | |
| 1 | 0.00 | 1.16 | 98.83 | 0.00 |
| 5 | 0.23 | 4.92 | 94.44 | 0.40 |
| 10 | 0.24 | 4.93 | 94.43 | 0.40 |
| 20 | 0.24 | 4.93 | 94.43 | 0.40 |
| **Relative variance in ΔSRLK** | | | | |
| 1 | 0.02 | 0.52 | 1.82 | 97.62 |
| 5 | 0.11 | 3.64 | 3.40 | 92.84 |
| 10 | 0.13 | 3.67 | 3.41 | 92.79 |
| 20 | 0.13 | 3.67 | 3.41 | 92.79 |

Figures in the first column refer to the time horizon (number of weeks). All other values in the table are rounded to two decimal places. The order of the variables was changed but there was no significant difference in the results after such changes. The time horizons were extended up to 50 weeks but the results did not change from those reported above.

**Table 5.13: Variance Decomposition for Sub-Period 2, January 2002- December 2010**

| | Percentage of Forecast Variance Explained by Innovations | | | |
|---|---|---|---|---|
| **Weeks** | **ΔBDSE** | **ΔINBSE** | **ΔPKSE** | **ΔSRLK** |
| **Relative variance in ΔBDSE** | | | | |
| 1 | 100.00 | 0.00 | 0.00 | 0.00 |
| 5 | 98.42 | 0.73 | 0.75 | 0.10 |
| 10 | 98.42 | 0.74 | 0.75 | 0.10 |
| 20 | 98.42 | 0.74 | 0.75 | 0.10 |
| **Relative variance in ΔINBSE** | | | | |
| 1 | 0.60 | 99.40 | 0.00 | 0.00 |
| 5 | 0.63 | 98.80 | 0.55 | 0.03 |
| 10 | 0.63 | 98.80 | 0.55 | 0.03 |
| 20 | 0.63 | 98.80 | 0.55 | 0.03 |
| **Relative variance in ΔPKSE** | | | | |
| 1 | 0.02 | 2.07 | 97.91 | 0.00 |
| 5 | 0.05 | 3.01 | 96.85 | 0.09 |
| 10 | 0.05 | 3.01 | 96.86 | 0.09 |
| 20 | 0.05 | 3.01 | 96.86 | 0.09 |
| **Relative variance in ΔSRLK** | | | | |
| 1 | 0.01 | 1.91 | 0.25 | 97.82 |
| 5 | 0.14 | 2.26 | 0.28 | 97.32 |
| 10 | 0.14 | 2.26 | 0.28 | 97.32 |
| 20 | 0.14 | 2.26 | 0.28 | 97.32 |

Figures in the first column refer to the time horizon (number of weeks). All other values in the table are rounded to two decimal places. The order of the variables was changed but there was no significant difference in the results after such changes. The time horizons were extended up to 50 weeks but the results did not change from those reported above.

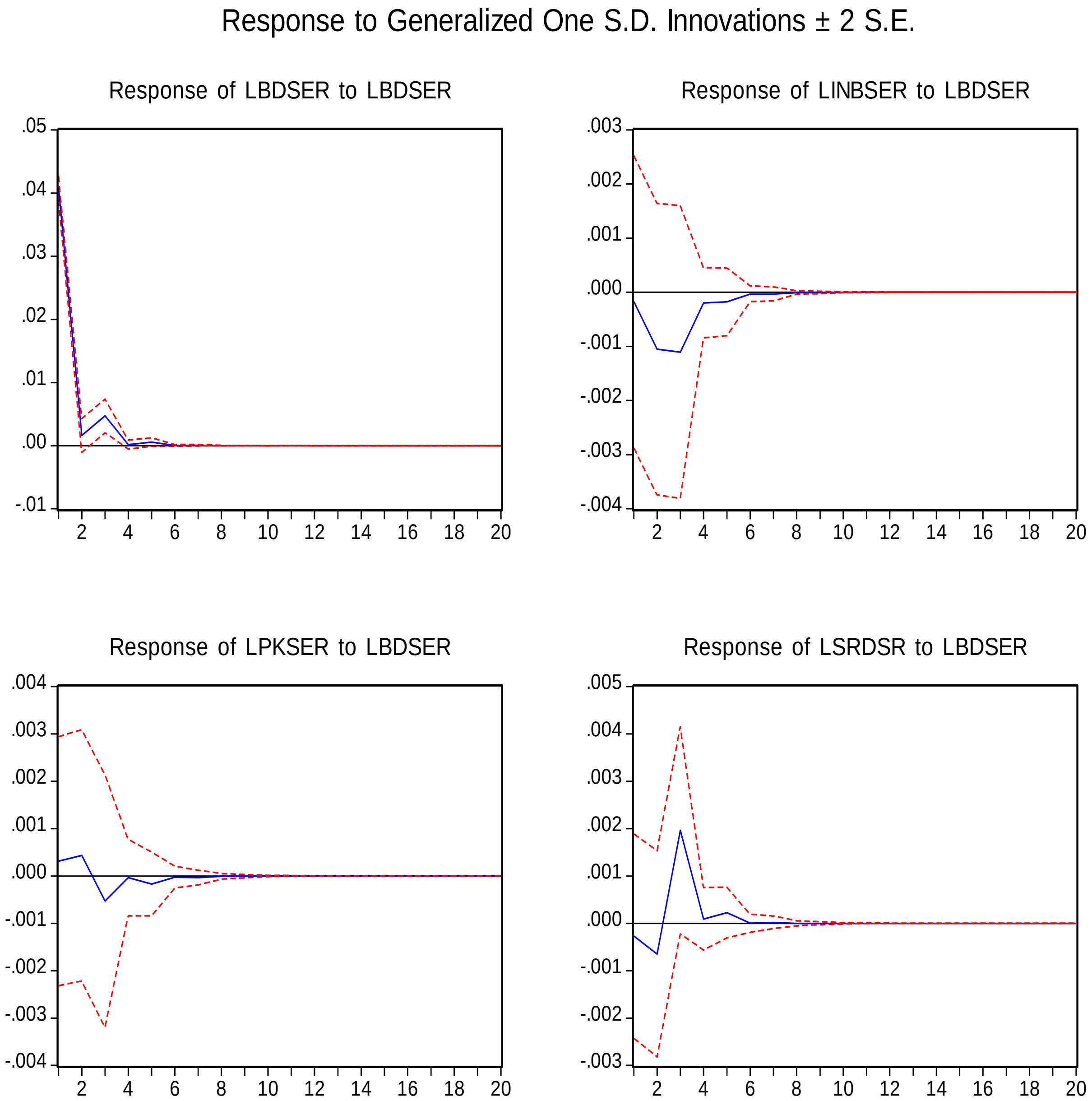
### 5.8: The Generalised Impulse Response Function Analysis

In addition to the variance decomposition analysis in the previous section, a generalised impulse response function analysis was conducted to further investigate the dynamic relationships among the stock markets of South Asia. This analysis provides the dynamic responses of each stock market to innovations in the market and in the other markets within the system. Analysis of an impulse response function shows the extent to which the shocks in one market are temporary or persistent in terms of their effects on their own and on other markets in the system of four markets being considered.

This thesis considers a system of the four South Asian markets. A total of 16 scenarios of impulse response functions are therefore possible for the entire sample period and for the two sub-periods. The impulse response paths are constructed from the shocks to one market and from the other three markets in this analysis. Figures 5.9 to 5.12 show the generalised impulse response functions for the four markets over the entire period from January 1993 to 2010. Figures for the impulse response function analysis for the two sub-periods from January 1993 to June 2001 and from January 2002 to December 2010 are shown Appendices, 5.1 – 5.3.

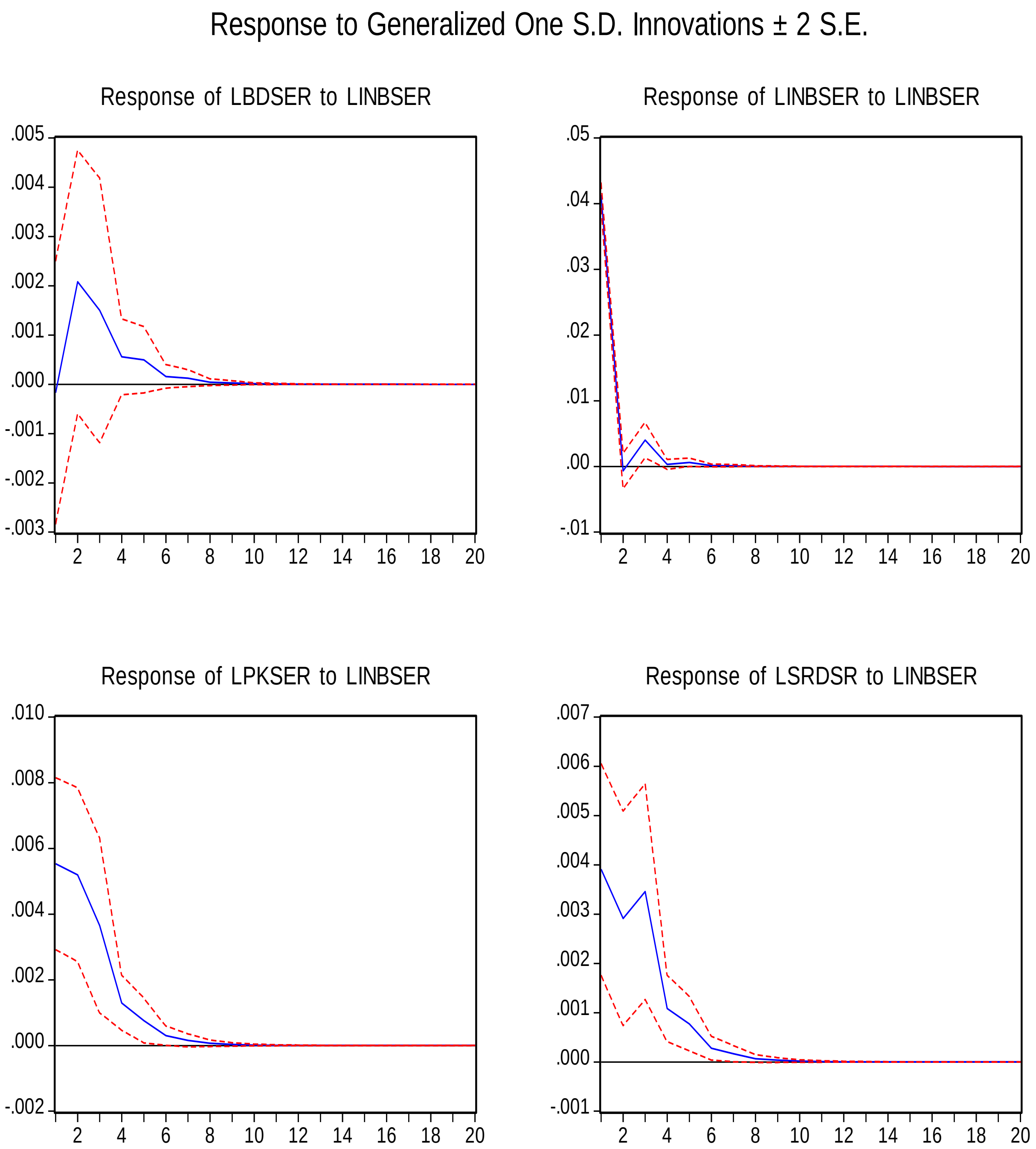
Starting with the impulse response function for the stock market in Bangladesh, a shock in the Indian market initially leads to a rise in the Bangladeshi market's equity values. The impact remains positive up to week eight after which the trend flattens out. Shocks to the Pakistani market have a positive effect on the Bangladeshi market as well, but this effect is minimal as compared to the Indian market and dies away soon after week three. Innovations in the Sri Lankan market initially have a negative effect on the Bangladeshi market which becomes positive after the third week and this persists until week eight. The Indian market shows a different picture for the generalised impulse response function. Innovations in the Bangladeshi market have no significant effect on the Indian market. Shocks to the Pakistani market exhibits a positive effect on the Indian market which dissipates after week eight. The Sri Lankan market has a declining positive effect on the Indian market. Overall, the Indian market does not appear to be affected by the innovations in the other three markets. According to the impulse response function for Pakistan, shocks in the Bangladeshi market have a minimal effect. The Sri Lankan and the Indian markets have a positive effect on the Pakistani market.

**Figure 5.9 GIRF for the Bangladeshi Market**



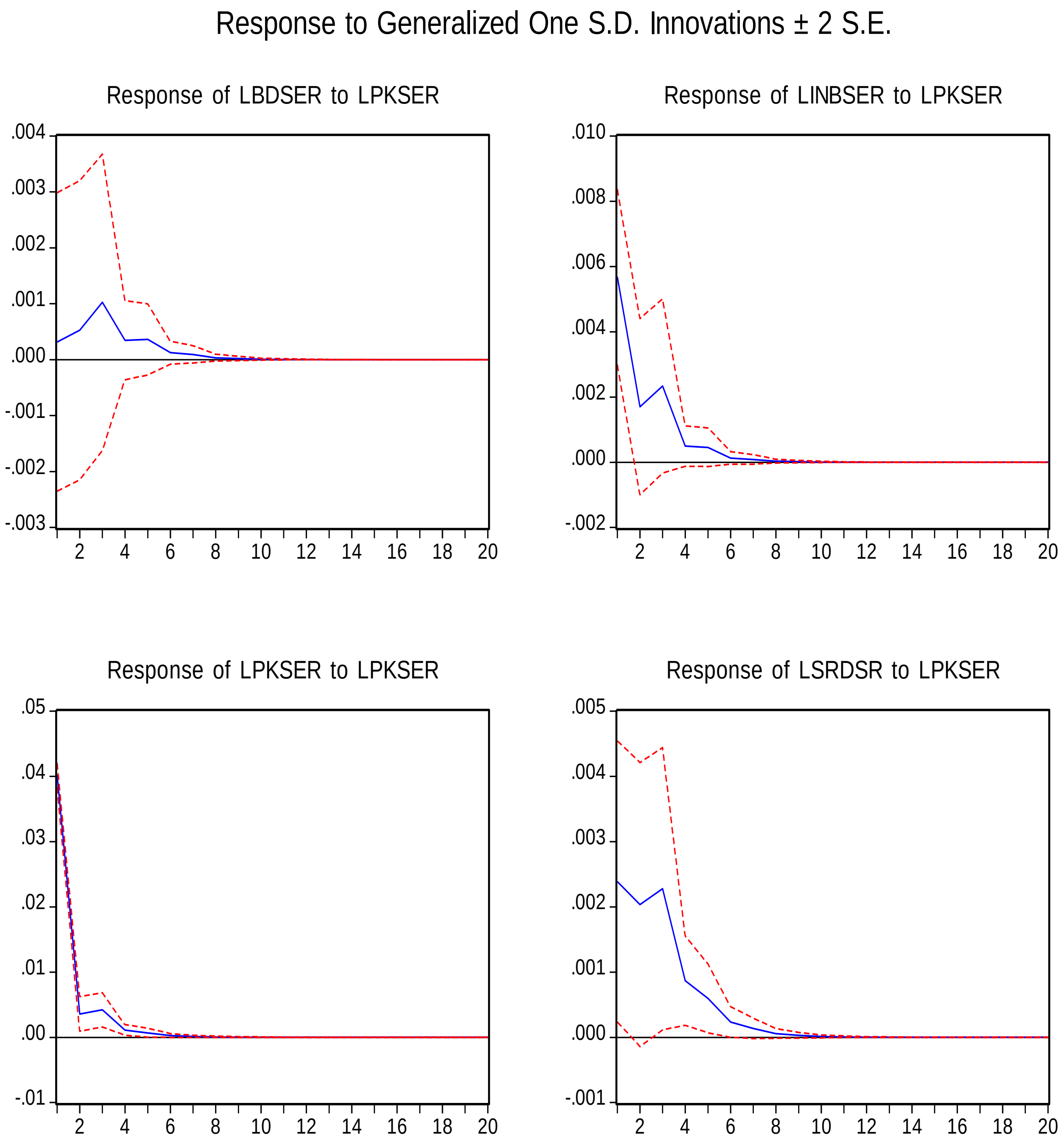

Response of the Bangladeshi market to innovations in own as well as the Indian, Pakistani and Sri Lankan markets.

**Figure 5.10 GIRF for the Indian Market**



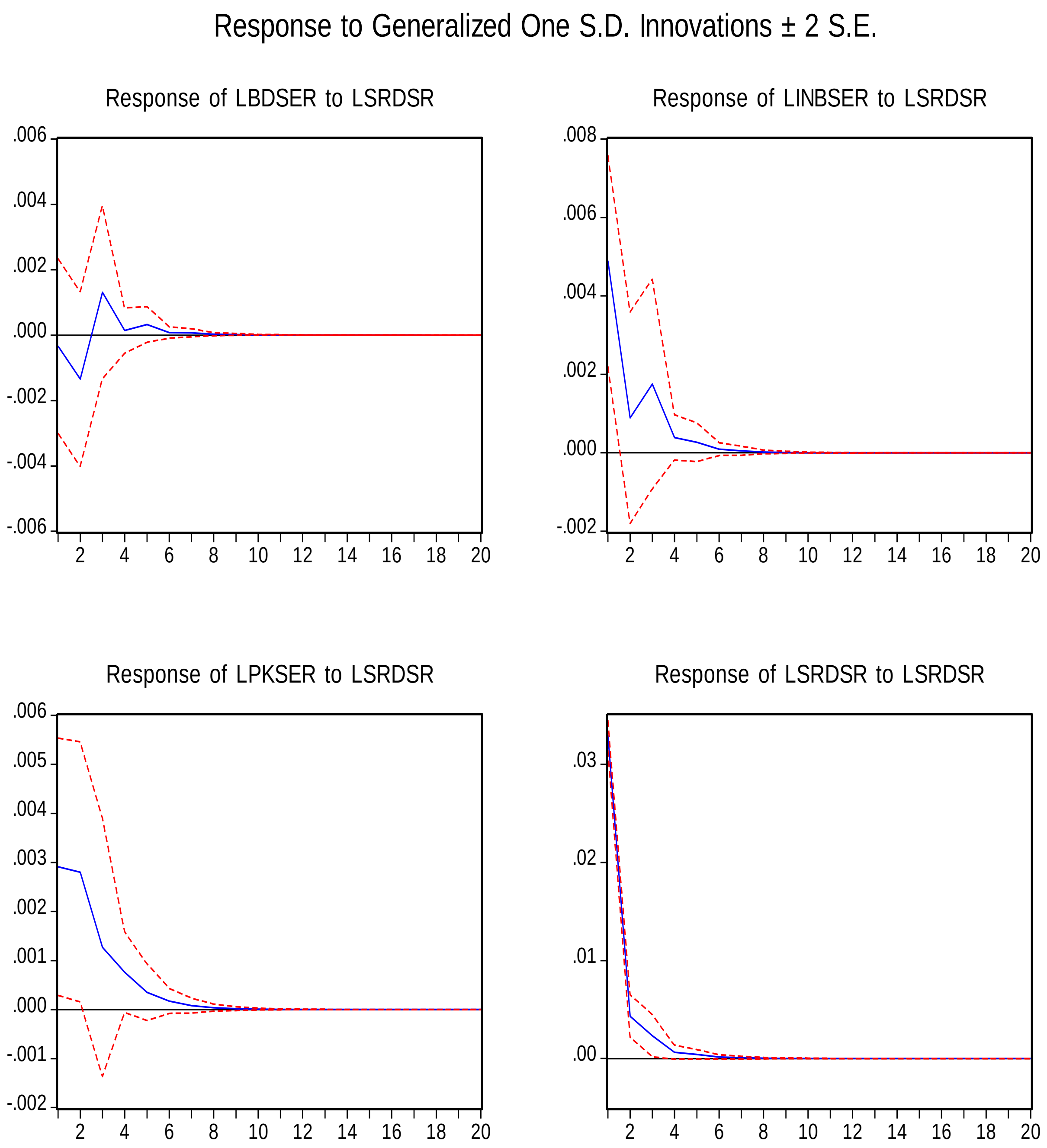

Response of the Indian market to innovations in own as well as the Bangladeshi, Pakistani and Sri Lankan markets.

**Figure 5.11 GIRF for the Pakistani Market**




Response of the Pakistani market to innovations in own as well as the Bangladeshi, Indian, and Sri Lankan markets.

**Figure 5.12 GIRF for the Sri Lankan Market**




Response of the Sri Lankan market to innovations in own as well as the Bangladeshi, Indian, and Pakistani markets.

Initially, these two markets have an increasing impact which dies away soon after week eight. Innovations in the Indian market have a positive but declining effect on the Pakistani market. The impulse response function for the Sri Lankan market shows positive effects from innovations in the Indian market. Shocks in the Pakistani market have a positive effect on the Sri Lankan market for the first nine weeks, which then becomes flat up to week ten. The Bangladeshi market initially has a negative effect on the Sri Lankan market which becomes positive after week three and persists until week five.

Overall, these results indicate that innovations in the Indian market have a significant effect on the other three markets of the region. This finding highlights the dominant role of the Indian market, which appears to lead the region's markets. In addition, the results from the generalised impulse response function analysis confirm the results from the VECM and the variance decomposition analysis in the previous sections.

## 5.9: Conclusion

This chapter investigates the dynamic linkages in the South Asian stock markets and adds to the literature on the inter-relationships among national stock markets. Most previous studies have tended to focus on the developed markets of the world; emerging stock markets are relatively less researched and research into the South Asian region is even more scarce. The results from studies on developed markets may not be applicable to emerging markets due to their unique business and financial environment. The current thesis focuses on the South Asian emerging markets because of the recent liberalisation policies and the opening of the stock markets to international investment.

This chapter examines the behaviour of share prices in four major South Asian stock exchanges over the period January 1993 to December 2010 and for the two sub-period of pre- and post- September 2001. The multivariate Johansen (1988) cointegration technique suggests that the four South Asian markets share one long-run equilibrium relationship. The results also indicate that integration among the markets has increased in recent years (post-September 11, 2001). In addition, the financial harmonisation policies in the region which resulted in the formation of the SAFE and the SAFTA may also have contributed to this increased integration. The VECM indicates that fluctuations in the share prices of one country in the region explain movements in each of the other nation's equities; an exception to this generalisation is the Bangladeshi market. A variance decomposition analysis shows that a considerable proportion of the stock market index variance is attributable to variations in the Indian market. Results from the generalised impulse response function reinforce the findings from the VECM and variance decomposition analysis.

The findings have important implications for international investors. The results suggest that investment in the South Asian stock markets offers limited diversification benefits in the long-run. However, in the short-run, investors may gain substantial benefits due to low return correlations between the markets. In addition, historical price changes in these markets can be used to predict share price changes in subsequent weeks. Therefore, the markets of Bangladesh, India, Pakistan and Sri Lanka, examined in this research are not weak form efficient.

# Chapter 6

## The Relationship between Share Returns and Macroeconomic Variables in the South Asian Emerging Stock Markets

## 6.1: Introduction

Various theories have been advanced to explain the asset-pricing process. Chief among these are the Capital Asset Pricing Model (CAPM), which postulates that variations in expected share returns are explained by changes in the return of the market portfolio and the share's beta (Sharpe 1964; Lintner 1965; Mossin 1966). By contrast, the Arbitrage Pricing Theory (APT) proposed by Ross (1976), assumes that share returns are explained by shocks in a number of unknown macroeconomic factors; the theory fails to identify both the number and nature of the relevant factors which are assumed to be important in explaining returns (Dhrymes et al., 1985). Chen et al. (1986) suggested that unanticipated changes in industrial production, interest rates, bond yields and inflation are possible factors which explain a security's returns.

Subsequent studies have documented that global as well as country – specific factors are important influences on share returns (Harvey 1995a, b; Fifield et al., 2002; Fifield and Power, 2006). For example, Fifield and Power (2006)[142] investigated the importance of both local and global factors in explaining equity returns using regression analysis and documented that these factors were associated with share returns in emerging markets countries. Similarly, Bilson et al. (2001) examined whether variations in four local macroeconomic variables (the money supply, goods prices, real activity and exchange rates) and the MSCI world index are associated with equity returns in 20 emerging markets[143]. Based on regression analysis, they found that the MSCI world index had a positive

[142] In particular, they investigated six local and six global economic variables along with three fundamental factors. Local variables included the consumer price index, foreign exchange rates, gross domestic product, short-term interest rates, the money supply and the trade balance. Global factors included world inflation, the world market return, world GDP, commodities prices, oil prices and US interest rates. Fundamental factors included market value, dividend yield and price to earnings ratio.

[143] These markets included six from Latin America: Argentina, Brazil, Chile, Colombia, Mexico and Venezuela, eight from Asia: India, Indonesia, Malaysia, Pakistan, the Philippines, South Korea, Taiwan and Thailand, three from Europe: Greece, Portugal and Turkey, one from the Middle East: Jordan and two from Africa: Nigeria and Zimbabwe.

relationship with returns from 10 emerging markets. This positive relationship indicated that any increase in emerging market returns were associated with a rise in the world market index; the authors attributed this positive association to the growing integration of emerging markets into the global financial system. The exchange rate was found to be the most influential local variable studied; the relationship between this variable and equity returns was significant in 12 markets. In most cases this significant relationship was found to be negative. Among the local variables, money supply was the second most important explanatory variable having significant coefficient values in six markets. The prices of goods and measures of real activity were found to have a limited influence on the variation in returns.

In this thesis, a total of 12 macroeconomic variables are investigated; seven of these are local variables including the consumer price index, exports, imports, the exchange rate, the industrial production index, the money supply and interest rates. Five global macroeconomic variables are studied including world GDP, world inflation, the world market return, oil prices and the US Treasury bill rate. The choice of these variables is based on empirical evidence from previous studies which suggests that most have a relationship with equity returns. Such a range of variables were used because relatively little is known about the actual relationship between macroeconomic variables and share returns in the South Asian region. The investigation thus facilitates an analysis of the association between the financial market and real economic activities in South Asian countries.

In this chapter, the determinants of asset returns are investigated by analysing the patterns of share returns in the emerging markets of South Asia. Any patterns detected may indicate that markets are inefficient since they may suggest that current share returns can be predicted based on historic macroeconomic information from any of the four countries in the South Asian region. In particular, for the four South Asian emerging markets over the 13-year period 1998-2010, a total of 12 macroeconomic variables are examined. There are two main objectives of the investigation. First, for all four emerging markets PCA is applied to the set of local and global economic variables in order to reduce the dimensionality of the economic variables dataset to a smaller number of important components. Second, regression analysis is used to investigate the possible relationship among the changes in local and global economic variables and share returns; the dominant PCs are extracted from the PCA and used as inputs into a regression analysis to explain the share returns in the four markets. The results of this regression analysis should build upon the empirical analysis of the previous chapter which suggested that equity returns from these four markets are influenced by a common cointegrating vector – at least in the second sub-period. The current chapter investigates whether such a common factor may be explained by global variables or whether local influences dominate in the South Asian emerging markets.

This chapter investigates the weak-form of the EMH because historical information about macroeconomic variables is used to explain variations in current share prices[144]. According to Patra and Poshakwale (2006, p. 993), "the predictability of returns by using macroeconomic information could be regarded as evidence of market inefficiency. Therefore by investigating the short and long-run relationship between macroeconomic variables and stock returns, conclusions regarding the efficiency of the stock market can be derived and relevant policy regulations to improve stock market conditions can be assessed". They argued that the ASE was informationally inefficient because available information on macroeconomic variables and trading volumes could be used to predict future share prices.

The current chapter investigates the weak-form of the EMH by examining local and global historical information. Each stock market is examined individually to analyse whether similar

[144] Again, this definition of the EMH differs slightly from that originally proposed by Fama (1965, 1970) which focused on historical information about a share's own past price changes. In the current thesis, the emphasis is on all historical information – including that in prior macroeconomic data. Some academics term investigations involving this later data source as a test of the semi-strong form of the EMH (Maysami et al., 2004).

or different local as well as global economic factors are important in explaining share price changes. An analysis of cross-country integration with respect to economic information is an area for future research. It is not studied in the current thesis. Thus, future research could see whether any integration among the markets is due to the linkages among economic fundamentals in the different markets. In addition, future research might investigate whether domestic or global economic factors are important in explaining share returns in the regional markets by analysing cross-country interactions among the domestic and international economic factors which are hypothesised to affect returns.

The rest of the chapter is organised as follows: Section 6.2 details the evidence from the literature about the relationship between macroeconomic variables and share returns. Section 6.3 introduces the dataset and analyses the descriptive statistics for the data. The correlation analysis in Section 6.4 is followed by the PCA in Section 6.5; the results from applying this method to the macroeconomic variables are examined. In Section 6.6, the role of local and global factors in explaining share returns in the South Asian emerging markets is studied. The final section offers a number of concluding observations.

## 6.2: Macroeconomic Variables and Share Returns: Evidence

An index of industrial production measures the level of output in an economy and is typically used as a proxy for Gross Domestic Product (GDP)[145]. The literature suggests that a rise in the output level due to higher demand will result in higher corporate profitability and lead to an increase in share prices. This positive association between output and share prices has been documented by various researchers. For example, Wongbangpo and Sharma (2002), Kim (2003), Fifield and Power (2006) and Humpe and Macmillan (2009), among others,

[145] Of the four countries, GDP data were not available on a monthly basis for any nation, therefore industrial production index data were used.

have reported that share prices and growth in output are positively related for both developing and developed countries. Indeed, after investigating the relationship between macroeconomic variables and share prices for the five ASEAN countries of Indonesia, Malaysia, the Philippines, Singapore and Thailand, Wongbangpo and Sharma (2002, p.38) reported that:

> "Growth in output and stock price indices are positively related in the long run; an increase in output increases future cash flow, corporate profitability, and, thereby, raises stock prices, while the opposite outcome is likely to occur in a recession".

By contrast, the literature suggests that share price changes tend to be negatively related to inflation; two possible reasons have been advanced to explain this association: (i) a rise in inflation may lower share prices because of the greater volatility in firm output prices which may occur; and (ii) higher inflation may lead to a depreciation in the currency which will result in increased (reduced) exports (imports) as local (foreign) products become cheaper (more expensive) for foreign (domestic) purchasers. A negative relationship has been documented between inflation and share prices by Fama (1981) and Chen et al. (1986). By contrast, Choudhry (2001) reported a positive association between share prices and inflation in hyper-inflationary environments in countries such as Argentina, Chile, Mexico and Venezuela. Wongbangpo and Sharma (2002) suggested that the reason for a positive association between the two variables in hyper-inflationary economies is that share prices act as a hedge against inflation. However, Sing and Low (2000) and Zhou et al. (2005) called this reasoning into question by suggesting that equity investments are poor hedges against inflation.

The evidence from existing studies on the relationship between the money supply and share prices is also mixed. For example, Wongbangpo and Sharma (2002) argued that a positive as well as a negative relationship may exist between share price changes and variations in the money supply. Specifically, they reported that:

> "*Ceteris paribus* an increase in the money supply creates an excess supply of money balances and an excess demand for equity, and results in an increase in equity prices. However, a negative effect of the money supply on stock prices is also conceivable through the positive inflationary effect" (p.30).

Humpe and Macmillan (2009) argued that these two variables are linked for the following reasons: (i) a change in the money supply causes unanticipated inflation which in turn negatively influences share prices; and (ii) changes in the money supply will affect the overall level of economic activity in a country and this will impact on share prices in a positive fashion.

Generally, a negative relationship has been reported between share prices and interest rates. Higher interest rates should result in an increased demand for interest-bearing securities and a reduction in the demand for equities because of the larger opportunity costs involved; hence, shares price should decline. On the other hand, a rise in interest rates might result in lower capital expenditure as a result of lower net present value estimates which in turn might reduce earnings, cut dividends and lead to lower share prices. The evidence from Chen et al. (1986) supports the hypothesis that the relationship between changes in interest rates and share returns is negative. Specifically, when Chen et al. (1986) measured the interest rate as the yield spread, they found a negative relationship with share returns. When they regressed share returns on unanticipated changes in the term structure (long-term government bond return – Treasury bill rate), they found negative coefficients of -5.017 and -5.905 on the equally-weighted and value-weighted NYSE index, respectively; both of these were significant at the ten per cent level. More recently, Nasseh and Strauss (2000) documented a long-run relationship between share prices and macroeconomic variables in France, Germany, Italy, the Netherlands, Switzerland and the UK. Using the Johansen cointegration method and variance decomposition techniques, they reported that local variables (such as industrial production, interest rates, business expectations and inflation) had a significant relationship with share prices in these countries. In addition, a number of macroeconomic variables including interest rates, equity prices and industrial production in some countries such as Germany had significant effect on the share prices of other countries in the sample. Laopodis (2011) arrived at a similar conclusion; he found that several economic variables such as industrial production, interest rates, retail trade and crude oil prices affected share prices in France, Germany, Italy, the UK and the US; this impact was present in both the pre- and post-Euro periods.

Among the macroeconomic factors studied, researchers have documented that exchange rates have a significant impact on the stock market returns of most ESM countries. One reason for this finding may have been the trade linkages between the emerging and developed countries. Abdalla and Murinde (1997) found that exchange rates Granger-caused share prices in some Asian countries. Using monthly data for equity prices and exchange rates over the period between 1985 and 1994 and applying cointegration and Granger causality tests, they found that exchange rates Granger-caused share prices in India, Korea and Pakistan whereas share prices Granger-caused exchange rates in the Philippines. One explanation for this causality was that exports in these countries were sizeable so that exchange rates were a key influence on share prices in these countries[146].

Evidence regarding the relationship between exchange rates and share prices is more mixed. In export-oriented countries, currency depreciation may have a positive impact on the

[146] Kwon and Shin (1999) investigated the relationship between economic variables and share returns in the Korean market. Their results indicated that both local and global economic factors were important in explaining changes in shares prices but that global factors were more important in the explanation than local inflation and interest rate changes. Their results were in agreement with Fifield et al. (2002) who investigated 13 emerging markets including Korea. They also suggested that global factors were more important than local factors in the Korean market.

domestic stock market (Mukherjee and Naka, 1995). For example, when the domestic currency depreciates relative to the US dollar, exports from the domestic market may become cheaper in the US market. Increased exports may result in higher corporate profitability for firms which sell their products to US customers and share prices may rise as a result. Kim (2003) documented a negative relationship between share prices and exchange rates in the US while a positive relationship between these two variables was reported by Wongbangpo and Sharma (2002) for Indonesia, Malaysia and the Philippines[147]. In the emerging market of Sri Lanka, Gunasekarage et al. (2004) found no significant relationship between exchange rates and share prices for equities traded on the Colombo stock exchange. More recently, similar results have been reported by Patra and Poshakwale (2006), when they uncovered no significant short- or long-run relationship between exchange rates and share prices for the Athens stock exchange.

Exports and imports are the elements which make up the trade balance in a country. Economic theory suggests that the expected relationship between share prices and the trade balance will depend on whether the country has a surplus or a deficit in net exports. A trade balance surplus should result in higher corporate profits and hence share price increases; the opposite may be true in the case of a deficit. On the other hand, exports and imports will be affected by any changes in the currency of a country. They may have an impact on stock market equity prices through that channel as well.

Theory as well as empirical evidence suggests that (with the exception of oil producing firms) the relationship between changes in oil prices and share returns is negative because an increase in oil prices should result in higher costs and, hence, lower equity values. Harvey

[147] They argued that the depreciation in the local currencies against the US dollar in Indonesia, Malaysia and the Philippines enhanced their competitiveness in the world exporting market and hence, had a positive impact on stock market performance. For Singapore and Thailand the relation between exchange rates and stock prices was negative, justified by the asset view of the exchange rate that the demand and value of local currencies are driven by foreign investors' willingness to hold local assets (Ajayi and Mougoue, 1996).

(1995a) found a significant negative relationship between oil prices and share returns in five of the six countries in his sample over the period 1976 to 1992: China, Colombia, Jordan, the Philippines and Taiwan. Not surprisingly, the relationship between oil price changes and share returns was positive for Venezuela - a major oil exporting country. Fifield and Power (2006) included oil prices as a global factor in their investigation of the influences on returns in 11 emerging stock markets; however, no significant relationship was found between oil price changes and equity returns during the period from 1991 to 2000. More recently, Laopodis (2011) documented a significant relationship between variations in the price of crude oil and share returns in France, Germany, Italy, the UK and the US, using the rolling-sample cointegration technique and a VAR methodology.

It is evident from the existing literature that other global factors such as world GDP, the world market return, the US Treasury bill rate and world inflation have relationships with emerging market share returns. To compare the results of this investigation with the analysis of Fifield et al., (2002) and Fifield and Power (2006) these global variables have been included in the current thesis when examining the relationship between macroeconomic variables and equity returns in the four South Asian emerging stock markets. Fifield and Power (2006) argued that, with the exception of world inflation, changes in all of these global variables have a significant impact on equity returns in emerging markets[148]. In addition, Fifield and Power (2006) reported that:

> "Given that investors diversify their investment internationally, it is reasonable to hypothesise that international factors, as well as domestic factors, will generate share returns. Even when financial markets are segmented, however, international factors will still influence returns; for as long as international factors have an impact on the domestic economy, these variables will be relevant to any investment decision" (p.5).

[148] A total of 11 emerging stock markets were investigated, including six from Asia and five non-Asian markets. The six Asian markets included Hong Kong, Korea, Malaysia, the Philippines, Singapore and Thailand. Non-Asian countries included Chile, Greece, Mexico, South Africa and Turkey.

## 6.3: Data and Descriptive Statistics

Monthly data are used from January 1998 to December 2010. The choice of this time period was based on the availability of data. The stock index data were downloaded from Datastream for the four South Asian markets examined in this thesis. Specifically, information for the Bangladesh SE All Share index (Bangladesh), the Indian BSE National 200-price index (India), the Karachi SE 100 index (Pakistan) and the Colombo All Share index (Sri Lanka) were obtained in the local currency. The returns for each index were then calculated using the following formula:

$$R_{it} = \ln(P_{it}) - \ln(P_{it-1}) \qquad (6.1)$$

Where $R_{it}$ is the nominal return on index *i* in month *t*, $P_{it}$ is the price level of the index in month *t*, $P_{it-1}$ represents the price level of the index for the previous month and ln represents the natural logarithm.

Month-on-month growth rates of economic variables and monthly interest rates are used in the PCA; these rates are stationary as required for the PCA method[149]. The loadings are used as weights of the growth rates and interest rates when calculating local and global factors - denoted as Local Principal Components (LPCs) and Global Principal Components (GPCs), respectively, in the regression model. LPCs and GPCs are therefore combinations of growth rates of economic variables and interest rates; they are stationary, so the OLS method can be applied to estimate the model. The world GDP growth data were only available on an annualised basis. Therefore, these data were converted to monthly values via interpolation; specifically, monthly values were calculated by dividing the annual figures by 12.

To analyse the relationship between macroeconomic variables and share returns for the South Asian emerging markets being investigated, a number of macroeconomic variables were

[149] The monthly interest rate was determined from the annualised rate; dividing the annualised rate by twelve.

studied. These variables have been highlighted in the literature as having relationships with equity returns. In particular, monthly data for 12 macroeconomic variables over the 13-year period (1998-2010) were obtained from Datastream and the International Financial Statistics yearbooks for the four markets examined in the current study[150]. These variables consisted of seven local or country-specific variables for Bangladesh, India, Pakistan and Sri Lanka and five global variables from January 1998 to December 2010. The choice of variables was based on their usage by various researchers in similar investigations for other countries. For example, Chen et al. (1986), Wongbangpo and Sharma, (2002), Fifield and Power, (2006) and Ahmed (2008) examined the relationship between share returns and changes in GDP or industrial production, interest rates, the money supply, exchange rates, exports, the consumer price index and trade balances. In addition, they studied whether variations in global variables such as world inflation, world GDP, the world interest rate, the world return and the US Treasury bill rate were related to equity returns for a number of developed and emerging markets. Local variables such as the consumer price index (CPI) to measure inflation, the foreign exchange rate (FXR) to provide some measure of a country's relationships with other nations' prices, the industrial production index (IPI)[151] which was used to proxy for the level of output in an economy, the money supply (MON) which also provided some insight into inflationary pressures in an economy, imports (IMP) and exports (EXP) to measure a country's level of international trade, and the treasury bill rate (TBR) to represent short-term interest rates were included in the analysis[152].

[150] The gaps in the Datastream data were filled from the International Financial Statistics yearbooks and an effort was made to ensure that both used the same source.

[151] The Sri Lankan Industrial Production Index was obtained from the Central Bank of Sri Lanka. The industrial production index was rebased in September 2008 and was combined with the General Manufacturing Production Index due to unavailability of industrial production data from the Datastream.

[152] For Bangladesh, India and Sri Lanka, the Treasury bill rate is a three month rate whereas for Pakistan, it is a six month rate due to unavailability of the three month rate. The Treasury bill rate for Bangladesh is a combination of the Bangladeshi call money rate rebased up to January 2001 and the Bangladesh Treasury Bill rate from February 2001 to December 2010.

Following the approaches of Harvey (1995a, b), Fifield et al. (2002) and Fifield and Power (2006), five global macroeconomic variables were included in the current investigation. Specifically, the world consumer price index (WCPI) was used to represent world inflation, world gross domestic product (WGDP)[153] was included as a measure of global economic activity, the world market return (WRET) was obtained from the MSCI world price index, oil prices (OIL) were added because of the world-wide importance of this commodity and the US three month Treasury bill rate (USTBR) was included to provide some measure of world short-term interest rates. For investors who diversify their holdings internationally, both local and global factors should have important influences on portfolio decisions (Fifield and Power, 2006).

A number of descriptive statistics were calculated for the monthly return series of the four South Asian markets[154]. In particular, the number of monthly observations (N), the mean (Mean), the median (Median), the standard deviation (Std. Dev), the maximum (Maximum) and the minimum (Minimum) values were calculated. In addition, a measure of skewness (Skewness) and kurtosis (Kurtosis) as well as the Jarque-Bera (Jarque-Bera) statistic were estimated to investigate whether the data are normally distributed. A number of points emerge from an analysis of Table 6.1. First, the number of monthly observations for the period represents quite a long time span; therefore, the results should not relate to a specific set of economic events or a certain economic climate. Second, the mean return varied slightly among the four markets. Bangladesh performed the best with mean return of 1.46 per cent per month. This was followed by Pakistan and India with mean return values of 1.32 per cent and

[153] Since data for world GDP were not available on a monthly basis, the annual data were obtained from Datastream and were interpolated to get a monthly series. The annual data was divided by 12 for each year to get monthly observations.
[154] The descriptive statistics in the previous chapter were calculated on a weekly basis. Thus a further analysis of monthly descriptive statistics is provided in the current chapter.

1.29 per cent, respectively. The lower average return for the period was that of Sri Lanka with a mean value of 1.21 per cent.

Third, returns of the markets were volatile with standard deviation values above 7.00 per cent per month during the sample period. The Sri Lankan market was the least risky with a standard deviation value of 7.50 per cent. Pakistan was the most risky market with a standard deviation value above the 10.00 per cent level. Bangladesh and India had standard deviations of 8.19 per cent and 9.60 per cent, respectively. Such a finding is not surprising since the information in Chapter 2 highlighted the turbulent economic and political conditions within the four countries over the time period being considered. The volatile nature of these markets is further confirmed by the spread between the maximum and minimum values. Pakistan showed the largest spread of 75.23 per cent, with Bangladesh, India and Sri Lanka having spreads of 68.66, 55.51 and 43.33 per cent, respectively. In Bangladesh, the minimum return value indicates that the equity index fell by over 40 per cent in one particular month; the minimum value for Pakistan was even larger at more than 42 per cent.

**Table 6.1: Summary Statistics for Each of the Four South Asian Markets, 1998 –2010**

| **Statistic** | **Country** | | | | |
|---|---|---|---|---|---|
| | **Bangladesh** | **India** | **Pakistan** | **Sri Lanka** | **World** |
| **N** | 155 | 155 | 155 | 155 | 155 |
| **Mean** | 0.0146 | 0.0129 | 0.0132 | 0.0121 | 0.0017 |
| **Median** | 0.0016 | 0.0307 | 0.0224 | 0.0088 ` | 0.0088 |
| **Maximum** | 0.2807 | 0.2674 | 0.3298 | 0.2381 | 0.1357 |
| **Minimum** | -0.4059 | -0.2877 | -0.4225 | -0.1952 | -0.2084 |
| **Std. Dev** | 0.0819 | 0.0960 | 0.1047 | 0.0750 | 0.0529 |
| **Skewness** | -0.4593 | -0.6595* | -0.7381* | 0.0353 | -0.6787* |
| **Kurtosis** | 8.6588* | 3.7869* | 5.6910* | 3.2238 | 4.7030* |
| **Jarque-Bera** | 212.26* | 15.23* | 60.84* | 0.3555 | 30.6315* |

Descriptive statistics are included in the table. N is the number of observations, Mean is the equally-weighted average of all monthly observations over the 13-year sample period 1998-2010. Median is the middle value for each series. Std. Dev indicates the standard deviation of the return series. Minimum and maximum indicate the lowest and highest returns, respectively. Skewness is the Kendall-Stuart measure of skewness, and Kurtosis is the Kendall-Stuart measure of kurtosis. The Jarque-Bera test examines whether the monthly return series are normally distributed for the four South Asian emerging markets. An * indicates significance at the five per cent level.

Fourth, the returns for Bangladesh, India and Pakistan were not normally distributed. In fact, they were negatively skewed and displayed signs of excess kurtosis. By contrast, returns for Sri Lanka were positively skewed; however, this positive skewness coefficient of 0.0353 was not significant at the five per cent level. Fifth, the Jarque-Bera test statistic confirmed that the return distributions for Bangladesh, India and Pakistan were not normal. Indeed, the Jarque-Bera test results indicated that the null hypothesis of a normal distribution was rejected with the exception of the Sri Lankan market.

Finally, the last column of Table 6.1 shows the descriptive statistics for the MSCI index as the world index. A comparison of the four South Asian countries with the world market return shows that the mean return of the world market was far lower and less risky. The spread between the maximum and minimum values was 33 per cent per month while the standard deviation value was relatively low. However, the skewness value for the world market was significantly negative and its distribution was not normal. In this respect, world market returns were similar to equity price changes in Bangladesh, India, Pakistan and Sri Lanka.

Table 6.2 reports summary statistics for the macroeconomic variables employed in this analysis. In particular, the table shows the mean growth rate and the standard deviations around these means for the macroeconomic variables over the period 1998 to 2010. The table indicates that money supply increased almost uniformly in the four markets over the sample period. The variations in money supply were higher in Bangladesh and lower in India with standard deviation values of 3.3 per cent and 2.2 per cent per month, respectively. Therefore, it is not surprising that the economies in these countries were characterised by inflation as measured by changes in the consumer price index although this increased at a lower rate than the money supply. Money supply grew at an average rate of 1.15 per cent per month, whereas the mean rate of inflation across the four markets was 0.775 per cent per month. Pakistan showed the lowest inflation rate of 0.1 per cent per month; Sri Lanka by contrast, suffered from the highest inflation rate of 0.8 per cent during the sample period. In addition, inflation was relatively constant in Sri Lanka with a standard deviation of 1.4 per cent per month during the period studied.

Economic output, as measured by the industrial production index, increased in all four markets. The highest growth in output was recorded by India (0.6 per cent) closely followed by Bangladesh (0.5 per cent). The standard deviation values (5.6 and 6.5, respectively) for output were relatively low for these two countries which indicates that industrial production grew at a fairly constant rate during the period. The economies of Pakistan and Sri Lanka grew at a lower rate of 0.3 per cent and 0.4 per cent per month with standard deviation values of 9.7 per cent and 5.9 per cent per month, respectively. The volatile nature of production output for Pakistan and Sri Lanka may have been due to the political unrest in the two countries (see Chapter 2); political unrest and the poor law and order situations may have resulted in the temporary closure of production facilities from time to time; this characterised the economy of Pakistan during 2005-2010 (*Daily The Nation*, January 1, 2010)[155].

These countries' currencies performed poorly against the US dollar. The currencies for all four markets depreciated relative to the US dollar, with a standard deviation value of above 10 per cent per month for all four markets. This depreciation in the currencies no doubt helped exports of these countries to grow; sales of goods and services abroad increased by 1.5 per cent per month in Bangladesh and India, and by 1.2 per cent and 1.0 per cent per month

[155] Along with political unrest, Pakistan faced frequent power failures during the period (*Daily The Nation*, July 28, 2011) which may have been another reason for the volatile production output.

for Pakistan and Sri Lanka, respectively. It is hardly surprising that this growth in exports was matched by a sizeable rise in imports - as manufacturers possibly imported raw materials for production purposes. In addition, the rising standards of living within these four countries (especially in India) may have contributed to an increased level of demand for goods from abroad. Furthermore, liberalisation of goods and services' markets within these countries may also have facilitated a rise in imports. Pakistan exhibited the highest growth in imports (1.4 per cent per month), followed by Bangladesh and India where the growth rates were 1.3 per cent for each country.

**Table 6.2: Summary Statistics of Economic Variables 1998 to 2010**

| Country | | Variables | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | **CPI** | **FXR** | **IPI** | **EXP** | **IMP** | **MON** | **TBR** |
| **Bangladesh** | Mean | 0.005 | 0.003 | 0.005 | 0.015 | 0.013 | 0.012 | 0.001 |
| | Std.Dev | 0.008 | 0.012 | 0.065 | 0.126 | 0.170 | 0.033 | 0.004 |
| **India** | Mean | 0.017 | 0.001 | 0.006 | 0.015 | 0.013 | 0.012 | 0.002 |
| | Std.Dev | 0.006 | 0.015 | 0.056 | 0.116 | 0.104 | 0.022 | 0.003 |
| **Pakistan** | Mean | 0.001 | 0.004 | 0.003 | 0.012 | 0.014 | 0.012 | 0.002 |
| | Std.Dev | 0.052 | 0.015 | 0.097 | 0.119 | 0.145 | 0.032 | 0.006 |
| **Sri Lanka** | Mean | 0.008 | 0.004 | 0.004 | 0.010 | 0.011 | 0.010 | 0.002 |
| | Std.Dev | 0.014 | 0.015 | 0.059 | 0.203 | 0.147 | 0.026 | 0.003 |

| | | **WCPI** | **WGDP** | **OIL** | **USTBR** | **WRET** |
|---|---|---|---|---|---|---|
| **World** | Mean | 0.003 | 0.004 | 0.011 | 0.005 | 0.001 |
| | Std.Dev | 0.002 | 0.021 | 0.104 | 0.013 | 0.053 |

The table shows the mean and standard deviation of the growth rates of the variables. CPI is the consumer price index. For India, inflation is shown instead of CPI due to the unavailability of data. FXR is the foreign exchange rate. IPI is the industrial production index, EXP indicates exports, IMP is imports, MON is the money supply and TBR is the Treasury bill rate for the four countries. The world variables include (WCPI) world consumer price index indicating world inflation, the world gross domestic product (WGDP), oil prices (OIL), the US three month Treasury bill rate (USTBR) and the world market return (WRET).

Finally, an inspection of Table 6.2 reveals that the Treasury bill rate for Bangladesh and India increased by 0.14 per cent and 0.15 per cent per month, respectively. The highest increase in the Treasury bill rate was recorded for Sri Lanka (0.20 per cent per month). In Pakistan this rate increased by 0.17 per cent per month[156].

## 6.4: Correlation Analysis

Tables 6.3 to 6.6 show correlations among the share prices, local macroeconomic measures and global macroeconomic variables for the four South Asian markets under investigation in this thesis over the sample period from January 1998 to December 2010. A visual inspection of these tables reveals that correlations among the variables were very high; one exception to this generalisation relates to the treasury bill rate where correlations with other variables in almost all countries were relatively low. In general, all countries showed strong positive correlations between share returns and local economic variables (except the Treasury bill rate). For example, in Pakistan the correlation between the returns on the index and six variables (CPI, EXP, EXR, IMP, IP and MS) were all significant at the five per cent level of significance. A similar pattern emerges in the other three countries with only minor differences in the strength of the associations being detected; for Sri Lanka and Bangladesh, changes in the CPI were positively associated with equity returns since correlations were greater than 0.8, while for India and Pakistan the correlations were only above 0.3. For India, EXR is negatively rather than positively associated with returns.

A second striking feature of these tables is the significant correlation between the world economic variables and returns. This is especially the case for world CPI, world GDP and Oil Prices which all have correlations of more than 0.6 with changes in equity prices for

[156] In Pakistan the Treasury bill rate is a six month Treasury bill rate instead of a three month rate due to unavailability of the latter.

Bangladesh, 0.8 for India and Pakistan and 0.7 for Sri Lanka. In addition, the world market return has a significant correlation with the relatively large markets of India and Pakistan. The findings suggest that all four countries have relatively open economies which are influenced by changes in global measures of economic activity.

A third finding from Tables 6.3 to 6.6 is that the correlations among the different measures of economic activity are relatively high. For example, 41 of the 42 correlations among the local economic variables are significantly different from zero for the Bangladeshi market. In addition, 32 of the 35 correlations between the local and global economic variables have p-values greater than 0.05. The correlations for the other three markets are almost similar to this result with only minor differences emerging.

The correlations between the world economic variables and local economic variables including the share prices were also high (in most cases significantly different from zero at the five per cent level of significance). The US Treasury bill rate is the only measure which was negatively correlated with the local economic variables in the four markets. Evidence of a strong correlation between share prices and macroeconomic variables in the four South Asian countries indicates the importance of including these variables in any investigation. In most of the cases, the correlations among the variables are highly significant at the five per cent level measured against the null hypothesis of the correlations between the variables being equal to zero. Although correlation analysis is a static measurement of the association between variables and does not reveal any causal relationship that may exist, it is evident that these variables are good candidates for PCA. For example, Dunteman, (1994) argued that when variables are highly correlated, then the correlated variables can be linearly transformed into a small number of uncorrelated measures. This small number of derived variables, known as PCs, should maximise the predictive potential of the original variables when considered independently whilst avoiding problems of multicollinearity.

**Table 6.3: Correlation Between Share Prices and Macroeconomic Variables: Bangladesh**

| Local Variables | BDSE | CPI | EXP | EXR | IMP | IP | MS | TBR |
|---|---|---|---|---|---|---|---|---|
| BDSE | 1.00 | | | | | | | |
| CPI | 0.87* | 1.00 | | | | | | |
| EXP | 0.84* | 0.98* | 1.00 | | | | | |
| EXR | 0.66* | 0.90* | 0.90* | 1.00 | | | | |
| IMP | 0.88* | 0.97* | 0.97* | 0.87* | 1.00 | | | |
| IP | 0.78* | 0.97* | 0.96* | 0.93* | 0.94* | 1.00 | | |
| MS | 0.93* | 0.98* | 0.96* | 0.84* | 0.97* | 0.93* | 1.00 | |
| TBR | -0.47* | -0.27* | -0.21* | -0.02 | -0.20* | -0.19* | -0.34* | 1.00 |
| **World** | | | | | | | | |
| MSCI | 0.13 | 0.24* | 0.29* | 0.28* | 0.30* | 0.25* | 0.20* | 0.11 |
| WCPI | 0.81* | 0.98* | 0.96* | 0.95* | 0.95* | 0.97* | 0.95* | -0.19* |
| WGDP | 0.78* | 0.98* | 0.97* | 0.92* | 0.95* | 0.97* | 0.94* | -0.18* |
| OIL PR | 0.69* | 0.86* | 0.87* | 0.85* | 0.88* | 0.87* | 0.81* | -0.02 |
| USTBR | -0.57* | -0.58* | -0.50* | -0.49* | -0.53* | -0.55* | -0.58* | 0.29* |

BDSE, CPI, EXP, EXR, IMP, IP, MS and TBR denote the standardised values of the Bangladesh share price index, the consumer price index, exports, exchange rates, imports, the industrial production index, the money supply and the Treasury bill rate. MSCI, WCPI, WGDP, OIL PR and USTBR denote the world market return, the world consumer price index, world GDP, oil prices and the US treasury bill rate. An * indicates that the correlations are significant at the five per cent level.

**Table 6.4: Correlation Between Share Prices and Macroeconomic Variables: India**

| Local Variables | INBSE | CPI | EXP | EXR | IMP | IP | MS | TBR |
|---|---|---|---|---|---|---|---|---|
| INBSE | 1.00 | | | | | | | |
| CPI | 0.39* | 1.00 | | | | | | |
| EXP | 0.92* | 0.45* | 1.00 | | | | | |
| EXR | -0.19* | -0.10 | 0.06 | 1.00 | | | | |
| IMP | 0.91* | 0.48* | 0.98* | 0.05 | 1.00 | | | |
| IP | 0.93* | 0.42* | 0.98* | 0.07 | 0.95* | 1.00 | | |
| MS | 0.92* | 0.46* | 0.98* | 0.11 | 0.97* | 0.98* | 1.00 | |
| TBR | -0.27* | -0.07 | -0.39* | -0.43* | -0.35* | -0.45* | -0.45* | 1.00 |
| **World** | | | | | | | | |
| MSCI | 0.50* | 0.05 | 0.26* | -0.63* | 0.27* | 0.26* | 0.21* | 0.45* |
| CPI | 0.89* | 0.31* | 0.96* | 0.17* | 0.94* | 0.97* | 0.97* | -0.53* |
| GDP | 0.91* | 0.43* | 0.96* | 0.05 | 0.96* | 0.97* | 0.97* | -0.45* |
| OIL PR | 0.88* | 0.26* | 0.89* | -0.15 | 0.90* | 0.85* | 0.84* | -0.20* |
| USTBR | -0.36* | -0.22* | -0.55* | -0.49* | -0.54* | -0.55* | -0.59* | 0.73* |

INBSE, CPI, EXP, EXR, IMP, IP, MS and TBR denote the standardised values of the India share price index, the consumer price index, exports, exchange rates, imports, the industrial production index, the money supply and the Treasury bill rate. MSCI, WCPI, WGDP, OIL PR and USTBR denote the world market return, the world consumer price index, world GDP, oil prices and the US treasury bill rate. An * indicates that the correlations are significant at the five per cent level.

**Table 6.5: Correlation Between Share Prices and Macroeconomic Variables: Pakistan**

| Local Variables | PKSE | CPI | EXP | EXR | IMP | IP | MS | TBR |
|---|---|---|---|---|---|---|---|---|
| PKSE | 1.00 | | | | | | | |
| CPI | 0.30* | 1.00 | | | | | | |
| EXP | 0.79* | 0.57* | 1.00 | | | | | |
| EXR | 0.53* | 0.54* | 0.89* | 1.00 | | | | |
| IMP | 0.85* | 0.58* | 0.97* | 0.84* | 1.00 | | | |
| IP | 0.89* | 0.28* | 0.79* | 0.61* | 0.83* | 1.00 | | |
| MS | 0.87* | 0.56* | 0.96* | 0.85* | 0.97* | 0.86* | 1.00 | |
| TBR | -0.09 | 0.80* | 0.26* | 0.29* | 0.32* | 0.09 | 0.28* | 1.00 |
| **World** | | | | | | | | |
| MSCI | 0.56* | 0.09 | 0.19* | -0.07 | 0.31* | 0.36* | 0.28* | 0.18* |
| CPI | 0.85* | 0.41* | 0.95* | 0.88* | 0.95* | 0.86* | 0.97* | 0.12 |
| GDP | 0.87* | 0.54* | 0.94* | 0.84* | 0.96* | 0.87* | 0.98* | 0.29* |
| OIL PR | 0.90* | 0.39* | 0.85* | 0.65* | 0.90* | 0.81* | 0.87* | 0.19* |
| USTBR | -0.26* | -0.18* | -0.60* | -0.72* | -0.52* | -0.37* | -0.53* | 0.17* |

PKSE, CPI, EXP, EXR, IMP, IP, MS and TBR denote the standardised values of the Pakistan share price index, the consumer price index, exports, exchange rates, imports, the industrial production index, the money supply and the Treasury bill rate. MSCI, WCPI, WGDP, OIL PR and USTBR denote the world market return, the world consumer price index, world GDP, oil prices and the US treasury bill rate. An * indicates that the correlations are significant at the five per cent level.

**Table 6.6: Correlation Between Share Prices and Macroeconomic Variables: Sri Lanka**

| Local Variables | SLSE | CPI | EXP | EXR | IMP | IP | MS | TBR |
|---|---|---|---|---|---|---|---|---|
| SLSE | 1.00 | | | | | | | |
| CPI | 0.83* | 1.00 | | | | | | |
| EXP | 0.83* | 0.90* | 1.00 | | | | | |
| EXR | 0.72* | 0.86* | 0.83* | 1.00 | | | | |
| IMP | 0.84* | 0.93* | 0.92* | 0.82* | 1.00 | | | |
| IP | 0.84* | 0.94* | 0.90* | 0.83* | 0.91* | 1.00 | | |
| MS | 0.92* | 0.97* | 0.91* | 0.85* | 0.94* | 0.95* | 1.00 | |
| TBR | -0.26* | 0.04 | 0.04 | -0.02 | 0.07 | 0.01 | 0.09 | 1.00 |
| **World** | | | | | | | | |
| MSCI | 0.29* | 0.20* | 0.34* | 0.10 | 0.38* | 0.30* | 0.28* | 0.35* |
| CPI | 0.84* | 0.98* | 0.91* | 0.93* | 0.93* | 0.94* | 0.97* | -0.02 |
| GDP | 0.81* | 0.98* | 0.88* | 0.85* | 0.92* | 0.94* | 0.96* | 0.06 |
| OIL PR | 0.76* | 0.87* | 0.87* | 0.75* | 0.93* | 0.83* | 0.86* | 0.16* |
| USTBR | -0.44* | -0.62* | -0.45* | -0.66* | -0.48* | -0.49* | -0.52* | 0.24* |

SLSE, CPI, EXP, EXR, IMP, IP, MS and TBR denote the standardised values of the Sri Lanka share price index, the consumer price index, exports, exchange rates, imports, the industrial production index, the money supply and the Treasury bill rate. MSCI, WCPI, WGDP, OIL PR and USTBR denote the world market return, the world consumer price index, world GDP, oil prices and the US treasury bill rate. An * indicates that the correlations are significant at the five per cent level.

### 6.5: Principal Components Analysis

To investigate the relationship between share returns and the local as well as global macroeconomic variables among the South Asian emerging markets, the thesis employed PCA to identify the relevant variables from the pool of seven local and five global variables under examination. As reported in Section 6.4, the variables under consideration are highly correlated; hence PCA was thought to be a reasonable method of analysis. PCA is a method which significantly reduces the number of correlated variables from *p* variables to a small number of uncorrelated *k* variables. According to Dunteman (1994, p.8):

> "If the variables are correlated, and especially if they are highly correlated, then we can linearly transform the *p* correlated variables into a relatively small set of *k* uncorrelated variables such that the *k* derived variables, if considered as independent variables, will maximize the prediction of the original *p* variables. The *k* derived variables which maximize the variance accounted for in the original variables are called principal components".

PCA was applied separately to the local and global economic data series of each of the four South Asian emerging markets and principal components were extracted; these were then used as inputs in a regression analysis. This regression sought to explain the index returns of the four countries included in the thesis. There are a number of appealing reasons for using PCA in the analysis. For example, according to Fifield and Power (2006), (i) a large number of theoretically important macroeconomic variables that may affect share returns can be considered; (ii) PCA, when used in combination with regression analysis, is effective in addressing the problem of multicollinearity; specifically, because the small number of derived *k* variables are orthogonal to each other, multicollinearity should not be a problem; and (iii) since the PCs are uncorrelated, each regression coefficient can be estimated independently of the other components; the regression coefficient for a particular component remains constant regardless of the addition to or elimination of other components to the model. This makes it easy to choose the optimal set of predictors of any size (Dunteman, 1994).

Table 6.7 summarises the results from employing the PCA to both local and global economic variables. In particular, Table 6.7 details the eigenvalues, the proportions and the cumulative proportions of variance explained by the PCs for the standardised series[157]. A visual inspection of Table 6.7 indicates that in all four emerging markets examined in this thesis, most of the variation in the original local and global factors can be explained by the first three local and two global PCs. For example, in India and Pakistan, the variance or eigenvalues of the first principal components are 2.097 and 1.834, respectively. These explain 30.0 and 26.2 per cent of the total variance of the seven local variables. The second PCs have eigenvalues of 1.181 and 1.299 for the two countries, respectively, and account for 16.9 and 18.6 per cent of the variation of the local variables. The third PCs in these countries have eigenvalues of 1.101 and 1.192 and contribute 15.7 and 17.0 per cent to an explanation of the variation in the two countries' variables respectively. Together the first three PCs account for 62.6 and 61.8 per cent of the variation in the macroeconomic variables for India and Pakistan, respectively. Similar patterns emerge for Bangladesh and Sri Lanka with the first three PCs accounting for 57.0 and 56.3 per cent of the variation in the seven local economic variables, respectively.

PCs for the global variables indicate that the first PC accounts for 35.3 per cent of the variation, whereas the second PC contributes 26.1 per cent in its explanation of the variation in the five global variables under examination. The proportion of variation explained by the remaining three global variables is negligible. In all cases therefore, the dimensionality of the global economic variables can be reduced from five to two.

[157] The standardised series is used for analysing the Principal Components Analysis; this form is desirable because of the different units of the variables. Wilks (2011) argued that when the variables have different units of measurement, they must be standardised because measurements in different units yield arbitrary relative scaling of variables which can result in an arbitrary relative weighting of the variances of the variables to be used in the correlation matrix for PCA.

**Table 6.7: Eigenvalues and Proportions of Variance Explained by the Principal Components: Local and Global Economic Variables**

| Country | | Principal Components | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| **Bangladesh** | Eigenvalue | **1.549** | **1.228** | **1.212** | 0.958 | 0.891 | 0.714 | 0.448 |
| | Proportion | 0.221 | 0.176 | 0.173 | 0.137 | 0.127 | 0.102 | 0.064 |
| | Cum-Proportion | 0.221 | 0.397 | 0.570 | 0.707 | 0.834 | 0.936 | 1.000 |
| **India** | Eigenvalue | **2.097** | **1.181** | **1.101** | 0.878 | 0.809 | 0.635 | 0.299 |
| | Proportion | 0.300 | 0.169 | 0.157 | 0.125 | 0.116 | 0.091 | 0.043 |
| | Cum-Proportion | 0.300 | 0.469 | 0.626 | 0.751 | 0.867 | 0.957 | 1.000 |
| **Pakistan** | Eigenvalue | **1.834** | **1.299** | **1.192** | 0.821 | 0.773 | 0.628 | 0.452 |
| | Proportion | 0.262 | 0.186 | 0.170 | 0.117 | 0.111 | 0.090 | 0.065 |
| | Cum-Proportion | 0.262 | 0.448 | 0.618 | 0.735 | 0.846 | 0.936 | 1.000 |
| **Sri Lanka** | Eigenvalue | **1.811** | **1.082** | **1.052** | 0.958 | 0.889 | 0.671 | 0.538 |
| | Proportion | 0.259 | 0.155 | 0.150 | 0.137 | 0.127 | 0.096 | 0.077 |
| | Cum-proportion | 0.259 | 0.414 | 0.563 | 0.700 | 0.827 | 0.923 | 1.000 |
| **World** | Eigenvalue | **1.766** | **1.304** | 0.955 | 0.652 | 0.323 | 0.000 | 0.000 |
| | Proportion | 0.353 | 0.261 | 0.191 | 0.130 | 0.065 | 0.000 | 0.000 |
| | Cum-Proportion | 0.353 | 0.614 | 0.805 | 0.935 | 1.000 | ----- | ------- |

The emboldened values indicate those principal components with eigenvalues greater than one, as well as those principal components which account for a large portion of the variation in the data. The cumulative proportion explained by the first three principal components is greater than 50 per cent for Bangladesh and Sri Lanka. For India and Pakistan it is greater than 60 per cent.

The emboldened values in Table 6.7 indicate the PCs that will be retained for the regression analysis. According to Kaiser's criterion, PCs with latent roots or eigenvalues greater than one should be retained (Kaiser, 1960). He argued that PCs with an eigenvalues of less than one contain less information. However, in some cases, applying Kaiser's criterion rigidly may result in discarding PCs that, while small, may be important[158]. For example, some variables may not be well represented by the large PCs and small PCs must be retained to

[158] In the current thesis, the Kaiser criterion is strictly followed because in all four markets the eigenvalues of the first three local PCs are greater than one, whereas for the global PCs, the criterion was satisfied by the first two PCs. The retained PCs explain variation ranging from a low of 56.3 per cent in Sri Lanka to a high of 62.7 per cent in India.

better represent these variables (Fifield and Power, 2006). Based on simulation studies, Jolliffe (1972) suggested that the Kaiser Criterion tended to result in very few PCs; he suggested a cut-off point of 0.7. One issue with Jolliffe's cut-off point is that, in some cases, it results in retaining twice as many PCs as the Kaiser criterion (Dunteman, 1994). Since the main objective of PCA is parsimony and the more PCs that are retained, the less parsimonious is the description of data, this thesis does not adopt the Jolliffe cut-off criterion. Another criterion would be to retain all those principal components that account for a given percentage of variation, for example, 80 per cent (Dunteman, 1994). All these criteria are arbitrary and various researchers have used different retention criteria for the principal components. For example, Fifield et al. (2002) retained PCs which accounted for 80 per cent of the variation in the variables whereas Fifield and Power (2006) retained PCs which accounted for only 70 per cent of the variation in the data set[159]. This thesis retained all principal components with latent roots greater than 1[160]. For both the local and global macroeconomic variables, the adoption of this criteria resulted in the retention of three PCs for the local variables in all four markets under investigation and two PCs for the global variables.

### 6.5.1: Factor Loadings of the Principal Components

Table 6.8(a) and (b) summarise the proportionate weight of each variable - also known as the factor loadings of the three retained PCs. In particular, the tables report the variables which are used to construct the three PCs highlighted in Table 6.7 as well as their factor loadings. A

[159] In the current thesis, variables were first made stationary by taking their first difference. This transformation resulted in the retention of more PCs than when the analysis was done using data in levels. In level form, two PCs explained over 80 per cent of the variation in the variables. However, according to Alexander (2001), the variables should be made stationary before PCA is applied, otherwise the first principal component will be dominated by the input variable with the greatest volatility.

[160] Relaxing the Kaiser criterion is not required in this thesis because in all cases the first three principal components had eigenvalues greater than one, and explained over 50.0 per cent of the variation in the dataset of Bangladesh and Sri Lanka and over 60.0 per cent in India and Pakistan. For the global variables, two PCs were retained these PCs have eigenvalues greater than one and explained over 60.0 per cent of the variation in the global variables dataset.

number of important points emerge from the tables. First, in all South Asian emerging markets, the first PC has a high correlation with exports, imports and the industrial production index; for India and Sri Lanka it also has a high correlation with the money supply. The three variables (exports, imports and industrial production) are the common variables in all four markets. The loadings of these variables for the first local principal component are almost the same in all South Asian markets with a few minor exceptions. For example, exports have relatively lower weightings in the first principal component for India and Sri Lanka with loadings of 0.575 and 0.585, respectively. Imports have a proportionately lower weight in the first local principal component for India and Sri Lanka; the proportionate weighting for imports is 0.594 and 0.546 for Bangladesh and Pakistan, respectively[161]. As a result, it was decided to label PC1 as 'economic activities' within a country since it is mainly made up of exports, imports and industrial production. By contrast, PC2 is constituted mainly from the treasury bill rate and inflation which may be termed as the 'real interest rate'. The variables for this PC include the treasury bill rate and the consumer price index, with the money supply and exchange rate variables being important in some markets. The loadings of the treasury bill rate variable in the second PC range from a low of 0.461 for Pakistan to a high of 0.866 for Sri Lanka. The loadings of other variables when constructing this PC are almost the same as each other with one exception - the CPI in Sri Lanka which had a loading of only 0.069[162]. PC3 has the exchange rate as a common variable in all four markets with the consumer price index as the second common variable. However, these second variables' loading is relatively small. The contribution of other variables to PCs varies across the four markets. The third PC is therefore labelled the 'real exchange rate' because of the relatively high loadings on the exchange rate and consumer price index variables. The exchange rate

[161] The relatively higher loadings of the two variables in the first PC in Bangladesh and Pakistan is due to the number of variables constructing the first PC; in Bangladesh and Pakistan three variables make up the first PC, whereas in India and Sri Lanka, four variables share higher weights in the first PC.
[162] The relatively small weight of the consumer price index in the Sri Lankan market in the second PC is due to the dominant loading of the Treasury bill rate in this market.

weighting for PC3 among the four markets ranged from a low of 0.386 for Sri Lanka to a high of 0.735 for India. In most cases, the factor loading for this variable was the common weighting to emerge from the PCA investigation[163]. According to the last column, these three local principal components explained more than 55.0 per cent of the variation in the seven variables in both Bangladesh and Sri Lanka; in India and Pakistan they accounted for more than 60.0 per cent of the variation.

The last panel of Table 6.8(a) reports the results when the global factors were analysed with PCA. The weighting for CPI, MSCI and the USTBR are relatively high in the first global principal component. World GDP and Oil Prices have relatively higher loadings in the second global principal component. Thus, PC1 for the global factors was more related to return on world financial assets while PC2 for the global factors was deemed to measure world economic activities. Together, these two principal components explained 61.4 per cent of the variation in the five variables. Therefore, dimensionality in the global economic variables is reduced from five to two.

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[163] In India and Sri Lanka, the consumer price index also contributed a sizeable amount to the construction of the third local principal component, while money supply contributed a reasonable loading in the third local principal component in Bangladesh and Pakistan (0.605 and 0.657, respectively).

**Table 6.8(a): Factor Loadings for the Dominant Principal Components**

| Country | Variables | PC1 | PC2 | PC3 | Cum. Proportion (%) |
|---|---|---|---|---|---|
| Bangladesh | CPI | 0.118 | **0.565** | **-0.213** | 57.0 |
| | EXP | **0.674** | -0.140 | -0.153 | |
| | EXR | 0.094 | **-0.390** | **0.399** | |
| | IMP | **0.594** | 0.026 | -0.229 | |
| | IP | **0.411** | 0.097 | **0.572** | |
| | MS | -0.007 | **0.477** | **0.605** | |
| | TBR | -0.024 | **-0.521** | 0.161 | |
| India | CPI | -0.011 | **0.509** | **0.544** | 62.7 |
| | EXP | **0.575** | -0.060 | -0.085 | |
| | EXR | 0.118 | -0.102 | **0.735** | |
| | IMP | **0.349** | **0.424** | **-0.367** | |
| | IP | **0.594** | -0.126 | 0.082 | |
| | MS | **0.356** | **-0.439** | 0.120 | |
| | TBR | 0.234 | **0.581** | 0.020 | |
| Pakistan | CPI | -0.076 | **0.617** | **0.215** | 61.8 |
| | EXP | **0.605** | 0.142 | 0.106 | |
| | EXR | -0.124 | **0.541** | **-0.408** | |
| | IMP | **0.546** | 0.228 | -0.253 | |
| | IP | **0.549** | -0.105 | -0.014 | |
| | MS | 0.107 | -0.175 | **0.657** | |
| | TBR | -0.044 | **0.461** | **0.529** | |
| Sri Lanka | CPI | 0.033 | -0.069 | **0.840** | 56.3 |
| | EXP | **0.585** | 0.114 | -0.139 | |
| | EXR | -0.347 | -0.005 | **-0.386** | |
| | IMP | **0.392** | **0.357** | 0.098 | |
| | IP | **0.359** | 0.082 | **-0.331** | |
| | MS | **0.489** | -0.291 | 0.020 | |
| | TBR | -0.117 | **0.866** | 0.079 | |
| World | CPI | **0.557** | 0.185 | ------- | 61.4 |
| | GDP | 0.172 | **0.628** | ------- | |
| | MSCI | **0.595** | -0.353 | ------- | |
| | OILPR | 0.295 | **-0.566** | ------- | |
| | USTBR | **0.467** | 0.355 | ------- | |

The table summarises the results from applying a PCA to the monthly local variables for the four South Asian countries and the selected global economic variables over the 13-year period 1998-2010. In particular, the factor loadings for those PCs that account for most of the variation in the data are reported. The highlighted values indicate those variables which have high loadings in each PC.

Table 6.8(b) reports the groups of variables which form the three local and two global principal components. In particular, only those variables with relatively higher loadings for that PC are grouped together for the four markets. The loadings are highlighted in Table 6.8(a). According to Dunteman (1994), the variable with the highest loading or weight for a PC should be used as a representative of that PC. However, in this thesis, weights or loadings for all variables are considered in the construction of the PC. This approach allows each variable - even those with small weights - to contribute to the construction of the PC.

**Table 6.8(b): Factor Loadings for the Dominant Principal Components**

| **Country** | **Local and Global Economic Factors** | | |
|---|---|---|---|
| | **PC1** | **PC2** | **PC3** |
| **Bangladesh** | EXP, IMP, IP | CPI, TBR, MS, EXR | EXR, CPI, IP, MS |
| **India** | EXP, IMP, IP, MS | CPI, TBR, MS, IMP | EXR, CPI, IMP |
| **Pakistan** | EXP, IMP, IP | CPI, TBR, EXR | EXR, CPI, MS, TBR |
| **Sri Lanka** | EXP, IMP, IP, MS | TBR, IMP, MS | EXR, CPI, IP |
| **World** | CPI, MSCI, USTBR | GDP, OIL PR | ----- --- |

The table summarises the results from applying the PCA to the monthly local and global variables in their first differenced form for the four South Asian emerging markets over the 13-year period 1998-2010. In particular, the table reports the groups of the local and global variables which contribute relatively higher loadings in the construction of the three local PCs and two global PCs.

The results of this PCA are similar to the findings of Fifield et al. (2002) with a few exceptions. For example, these authors documented that most local economic data in emerging markets could be distilled into two PCs; in this thesis, three local PCs are retained. In addition, they noted that GDP, inflation, money supply, interest rates, exchange rates and the trade balance constituted the first two principal components in most countries with the exception of Hong Kong where three PCs were required to fulfil the retention criteria. The global factor loadings in this analysis show that two PCs explain most of the variation. World inflation, the world return and the US treasury bill rate had high loadings in the first PC while world GDP and Oil prices had high weightings in the second global PC. With the exception of oil prices, all these variables contributed to the global principal components which Fifield et al. (2002) uncovered[164].

[164] Fifield et al. (2002) used the retention criterion of retaining PCs which accounted for at least 80 per cent of the variation in the dataset. Using this criterion they retained three local and three global PCs in their analysis.

### 6.6: The Role of Local and Global Macroeconomic Variables in South Asian Emerging Market Share Returns

In this part of the investigation, the dominant PCs from the PCA which are highlighted in Tables 6.7 and 6.8 (a) and (b) were used as inputs to a regression analysis. From this analysis, the index returns of the four South Asian emerging markets were investigated. Specifically, two regression models were studied. First, the monthly returns of each country's equity index over the period January 1998-December 2010 were regressed on the three (lagged) local principal components. The regression model took the form:

$$R_{it} = \alpha_i + \beta_1 LPC_{1t-1} + \beta_2 LPC_{2t-1} + \beta_3 LPC_{3t-1} + \varepsilon_t \qquad (6.2)$$

Where $R_{it}$ is the index return for market $i$, $LPC_{1t-1}$ is the first local principal component, $LPC_{2t-1}$ is the second local principal component, $LPC_{3t-1}$ is the third local principal component and $\varepsilon_t$ is a random error term.

Second, the monthly returns were regressed on both the local and the global (lagged) principal components. This second regression model took the form:

$$R_{it} = \alpha_i + \beta_1 LPC_{1t-1} + \beta_2 LPC_{2t-1} + \beta_3 LPC_{3t-1} + \beta_4 GPC_{4t-1} + \beta_5 GPC_{5t-1} + \omega_t \qquad (6.3)$$

Where $R_{it}$ is the index return for market $i$, $LPC_{1t-1}$ is the first local principal component, $LPC_{2t-1}$ is the second local principal component, $LPC_{3t-1}$ is the third local principal component, $GPC_{4t-1}$ is the first global principal component and $GPC_{5t-1}$ is the second global principal component and $\omega_t$ is a random error term.

Estimation of equation (6.2) permits an analysis of the impact of local principal components on the index returns of the four South Asian emerging markets. Equation (6.3) in conjunction with equation (6.2) can be used to identify the incremental change in the explanatory power from adding the global principal components to the local principal components information set. An analysis of the model also facilitates a test of the significance of each local and global principal component in explaining the returns earned in each of the South Asian emerging markets.

Table 6.9 reports the results from estimating equations (6.2) and (6.3). The table reports the coefficient values of each principal component with their corresponding p-values in parenthesis. The adjusted $R^2$ values for the local-only regressions and for the local and global regressions are also shown[165]. OLS was used to estimate the regression with the standard errors adjusted for Heteroskedasticity and autocorrelation using the Newey-West procedure; the corrected standard errors were Heteroscedasticity- and autocorrelation- consistent (HAC) or Newey-West standard errors (Gujarati, 2002)[166]. A visual inspection of Table 6.9 reveals a number of findings. First, the ability of both local and global variables to explain returns in the four South Asian emerging markets returns is limited. For example, the explanatory power of the local components ranges from a low of 1.4 per cent in Pakistan to a high of 3.7 per cent in Sri Lanka. In three of the four markets studied (India, Pakistan and Sri Lanka), the total variation explained increases on the addition of the global principal components to the regression model. However, a sizeable proportion is still unexplained for the returns in these markets. For example, the adjusted $R^2$ is highest for the model which includes both local and global principal components in Sri Lanka, but 95.0 per cent of the total variance of returns

[165] The figures with an * represent those principal components that are significant at the five per cent level.
[166] In a large sample, the Newey-West procedure is used to correct the standard errors for both Heteroscedasticity and autocorrelations unlike the White procedure which only corrects the standard errors for Heteroscedasticity (Gujarati, 2002).

still remains unexplained. The results are different from those reported in studies for developed markets, but are very similar to the results reported for emerging markets[167]. For example, Bilson et al. (2001) documented that the adjusted $R^2$ values in their regressions ranged from a low of -0.01 to a high of 38.0 per cent for a sample of 20 emerging markets and five macroeconomic variables[168]. In addition, Fifield et al. (2002) reported that six domestic and six global variables, similar to those examined in this thesis, explained between 0.0 per cent and 14.6 per cent of the variation in returns for a sample of 13 emerging markets. In a more recent investigation of 11 emerging markets, Fifield and Power (2006) found that both local and global factors explained only a minority of the variation in share returns; their $R^2$ values ranged from 0.4 to 34.1 per cent[169].

Second, the importance of local and global factors is different across the four markets. In all four markets, local factors are relatively important in explaining share returns; global factors add relatively little to the explanation of share returns in these markets. For example, in India, Pakistan and Sri Lanka, the addition of the global variables increases the $R^2$ to 2.9, 3.3 and 5.0 per cent, respectively. Therefore, the results provide support for the view that domestic forces affect returns in these markets. In general, the findings concerning economic factors are similar to the results of Harvey (1995) who discovered that local factors were important in explaining share returns in emerging markets. Harvey (1995) indicated that global factors

[167] Sorensen et al. (1989) reported that a model employing seven domestic variables mostly similar to those investigated in this thesis explained on average 41 per cent of the fluctuations in US share returns.

[168] The variables investigated included the world market return, money supply, goods prices, real activity and exchange rates. In addition, after extracting four PCs from 14 economic and fundamental variables, they reported that for the 20 countries $R^2$ values ranged from a low of 2.0 per cent in Venezuela to a high of 45.0 per cent in Indonesia.

[169] For comparability with previous studies, for example (Bilson et al., 2001; Fifield et al., 2002), the thesis also investigates the contemporaneous relationship among share returns and macroeconomic variables. This contemporaneous model fit is better than the lagged model with an adjusted $R^2$ value of 23.5 per cent for the Indian market. Results for the contemporaneous relationship between share returns and macroeconomic factors are located in Appendix 6.1.

were not significant in explaining ESM returns[170]. In addition, Hondroyiannis and Papapetrou (2001) argued that although macroeconomic activities affected the performance of Greek equities, fluctuations in the Greek stock market were not fully predictable as a substantial proportion of the variation in returns was not explained by the macroeconomic variables.

**Table 6.9: Regression Analysis of Monthly Shares Returns for the Four South Asian Emerging Markets**

| Country | LPC1 | LPC2 | LPC3 | GPC1 | GPC2 | $R^2L$% | $R^2L\&G$% |
|---|---|---|---|---|---|---|---|
| **Bangladesh** | -0.011* | 0.008 | 0.009 | ------ | ------ | 3.2 | ------ |
| | (0.017) | (0.215) | (0.082) | | | | |
| | -0.012* | 0.008 | 0.010* | 0.007 | 0.001 | ------ | 3.0 |
| | (0.007) | (0.257) | (0.047) | (0.081) | (0.865) | | |
| **India** | 0.003 | -0.004 | -0.017* | ------ | ------ | 2.0 | ------ |
| | (0.575) | (0.527) | (0.021) | | | | |
| | 0.004 | -0.004 | -0.017* | -0.003 | 0.008 | ------ | 2.9 |
| | (0.512) | (0.476) | (0.045) | (0.582) | (0.203) | | |
| **Pakistan** | 0.006 | -0.015* | 0.004 | ------ | ------ | 1.4 | ------ |
| | (0.379) | (0.048) | (0.575) | | | | |
| | 0.005 | -0.015* | 0.004 | 0.009 | 0.012 | ------ | 3.3 |
| | (0.379) | (0.050) | (0.530) | (0.166) | (0.100) | | |
| **Sri Lanka** | 0.006 | -0.015* | 0.001 | ------ | ------ | 3.7 | ------ |
| | (0.129) | (0.027) | (0.727) | | | | |
| | 0.005 | -0.015* | -0.002 | 0.009 | 0.004 | ------ | 5.0 |
| | (0.184) | (0.035) | (0.792) | (0.154) | (0.532) | | |

The table reports results from regressing the lagged local and global principal components on the monthly returns of the four South Asian markets over the 13-year period 1998-2010. In particular, the table reports the coefficient values for the local and global principal components, the p-values and the adjusted $R^2$ values for the local regression ($R^2L$) and for the global and local regression ($R^2L\&G$). An * indicates the coefficient values for the principal components significant at the five per cent level.

Third, the significance of the local principal components varies across the four markets; for example, in Bangladesh, the first and third PCs are significant while in India only the third PC is significant. In Pakistan and Sri Lanka the second local PC is important. According to Table 6.9, these results suggest that 'economic activities', the 'real interest rate' and the 'real

[170] By contrast, Fifield et al. (2002) found that both local and global factors were important in explaining share returns in ESMs. They found that global factors were more important in explaining returns in Greece, Korea, Mexico, Portugal, Singapore and Thailand, while local variables were more important in explaining share returns in India and Turkey. The results for the Indian market are consistent with the findings of Fifield et al. (2002).

exchange rate' have a small but important impact on share returns in these emerging markets. The importance of local components for these emerging markets is not wholly surprising given that these countries' economies are less integrated into the global financial system than the other emerging countries of the world. For example, Lamba (2005) argued that, with the exception of the Indian market which was influenced by the developed markets of the US, the UK and Japan, the Pakistani and Sri Lankan markets were relatively isolated from the developed markets of the world. By contrast, Fifield et al. (2002) found that domestic economic factors were important in explaining share returns in India, which corroborates the findings in this chapter. In addition, Chapter 2 highlighted that foreign investment in Bangladesh was lower than foreign investment in other South Asian countries over the last decade, indicating that this market is segmented from the developed markets of the world.

Fourth, local factors are found to be relatively more important than global factors; in all four markets, local variables were important but no significant relationship was found with global factors in these markets at the five per cent level. These findings are not wholly surprising because of the low levels of integration of these emerging markets within the world financial system. For example, Korajczyk (1996) found that emerging markets were more segmented than developed markets. More recently, Bekaert and Harvey (2002) argued that although increasing with time, the integration of emerging markets is still lower than in the developed markets.

Finally, global variables appear to be of limited importance in Bangladesh; explanatory power decreased on the addition of the global components from 3.2 to 3.0 per cent. The diminishing explanatory power that occurs on the addition of the global components in this market is not surprising. In comparison to the rest of the markets, the Bangladeshi market is more segmented as it has less exposure to international factors due to problems with thin trading and low levels of foreign investment.

The results in this chapter support the earlier findings in Chapter 5 which indicated that the markets in the South Asian region are not weak form efficient. The findings also support the argument that the presence of a relationship between lagged macroeconomic variables and share returns calls the assumption of weak form efficiency into question. For example, Maysami et al. (2004) argued that when share prices accurately reflect the underlying economic fundamentals, returns should act as leading indicators of future economic activities, and not the other way around. The small but significant lagged effects from the macroeconomic variables to share returns in the chapter indicates that the South Asian markets are informationally inefficient. This means that investors can earn abnormal profits by exploiting historical macroeconomic information. The results in the current chapter are also in agreement with the findings of previous studies which have investigated the relationship between share returns and macroeconomic variables for other emerging markets[171].

## 6.7: Conclusion

This chapter has analysed the effect of local and global macroeconomic variables on share returns in the four South Asian markets of Bangladesh, India, Pakistan and Sri Lanka. The PCA method was employed to enable the investigation of theoretically important economic factors which may affect share returns in these markets. To compare findings with Chen et al. (1986); Harvey (1995); Fifield et al. (2002) and Fifield and Power (2006), the thesis investigated seven local economic variables: exports, imports, industrial production, exchange rates, short-term interest rates, the money supply and inflation were analysed.

[171] For a detailed review of these studies, the reader is referred to Chapter 3.

However, as found by various researchers, both local and international economic factors are important in explaining share returns in emerging markets. Thus, the chapter investigate five global variables including World GDP, the world market return, world inflation, Oil Prices and the US treasury bill rate. Similar to previous studies, the results in this chapter confirmed that contemporaneous changes in both local and global factors were important in explaining variations in share returns in the South Asian markets. Investigating the lagged PCs, the importance of the local and global factors varied among the markets; in all markets one or two local economic factors were significant but lagged global factors were not significant in any market. The findings of the chapter indicate that only local historical macroeconomic information were important in explaining future share price changes in the South Asian emerging markets.

The results also indicated that variation in share prices in the region could be predicted from contemporaneous as well as historical changes in the macroeconomic factors. Therefore, the results can help investors make effective investment decisions by estimating the trends in local and global economic factors in these markets and earning continuous abnormal profits based on historical information. The findings of the chapter indicate that both contemporaneous and lagged changes in the macroeconomic variables can predict share returns in the four markets and hence they are not weak form efficient.

# Chapter 7

# Return and Volatility Spillovers Among the Four South Asian Emerging Stock Markets

## 7.1: Introduction

This chapter investigates the dynamic linkages among the emerging stock markets of Bangladesh, India, Pakistan and Sri Lanka from the perspective of return and volatility transmissions. It therefore builds upon the findings of the previous chapters which suggested that equity prices in these four South Asian markets were related to one another. The current chapter investigates this issue in greater depth by examining whether the linkages relate to returns or volatility (or both). The extent of any linkages in these stock markets has implications for domestic economic activity and international investors. Strong linkages among the markets may reduce their isolation from foreign markets and hence, expose these countries' economies to external shocks from other markets[172]. An external shock which affects one market may be transmitted to another because of spillover effects which may be present. In addition, it is argued that linkages among markets can hamper the ability of national governments to adopt economic policies that may be appropriate for their countries. For example, Li and Majerowska (2008) argued that strong linkages limit the scope for independent monetary policy in a country since flows to and from other economies may mitigate against any restrictions imposed. From the perspective of international portfolio diversification, strong linkages among markets reduce the gains from international diversification. By contrast, weak linkages, where return correlations between emerging markets are less than perfect, offer gains from international portfolio diversification[173]. Finally, it has been suggested that linkages between markets may offer profitable arbitrage opportunities for investors since a market may not be efficient with respect to return or risk changes that occur in other markets.

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[172] Sing et al. (2010) argued that strong linkages reduce the isolation of domestic markets from global shocks, whereas weak linkages offer gains from international diversification.

[173] The reader is referred to Chapters 3 and 5 for more details on stock market integration and the benefits from international diversification.

The remainder of the chapter is organised as follows. Section 7.2 briefly outlines the existing literature relevant to the topic of return and volatility spillover effects. Section 7.3 describes the data and reports on the preliminary analysis while Section 7.4 documents the empirical results. Section 7.5 describes the results for the sub-periods and Section 7.6 summarises the conclusions.

## 7.2: Overview of the Literature

The issue of integration among international stock markets has recently become the focus of a great deal of research. This area of research has attracted the attention of researchers who wish to examine whether any turmoil which occurs in one market has consequences for other markets' share prices. In particular, numerous studies have investigated the extent of any interdependence among equity markets especially after the 1987 global stock market crash and the Asian crisis of 1997, which not only affected US and Asian equities but also transmitted shocks to other markets throughout the world (Wang et al., 2005). In addition, the liberalisation policies adopted by various countries which allow capital to flow more freely among markets suggest that this topic is of growing importance. Indeed, advances in information and communication technologies which have improved information processing and enhanced the possibilities for national financial markets to react quickly to new information from international stock exchanges indicates that financial shocks may be transmitted from one country to another.

Most of the previous studies investigating integration among stock markets have focused on the developed markets (Hamao et al., 1990; Theodossiou and Lee, 1993; Koutmos and Booth, 1995; Kanas, 1998)[174]; only a relatively small number have investigated ESMs. In addition, a majority of the studies that have investigated the inter-relationship between emerging markets have concentrated on countries in Latin America, Europe, the Middle East and South West Asia, using a cointegration and VAR framework (Chen et al., 2002; Gilmore and MacManus, 2002; Syriopolus, 2004; Diamandis, 2009)[175]. Research on the linkages among the emerging markets of South Asia is limited. Indeed, the limited literature that has been published on South Asian markets is also typically carried out using the cointegration framework which investigates whether there is any integration among share prices or equity indices (e.g., Narayan et al., 2004; Lamba, 2005); they typically ignore other aspects of security performance such as risk. By contrast, Li and Majerowska (2008) argue that if markets are integrated, an anticipated event in one market will influence not only the return but also the variance of price changes in other markets. An analysis of volatility is therefore important as the mean level of returns in one market may be unaffected by news from another market even though the risk of the equities may alter.

Very few studies have investigated the linkages among stock markets in terms of both return and volatility spillovers and those that have done so initially employed univariate or bi-variate GARCH approaches. For example, Hamao et al. (1990), Liu and Pan (1997), Kanas (1998) and Wang et al. (2005) are a few among those that have used these approaches. In addition, most of these studies focus on return and volatility transmission from the developed markets of Japan, the US and the UK, and hence these studies are predominantly occupied with testing the influence of markets in developed countries on other stock exchanges. As Chapter 3 indicated, Hamao et al. (1990), Bekaert and Harvey (1995) and Karolyi and Stulz

[174] Hamao et al. (1990) studied the markets of Japan, the UK and the US. Theodossiou and Lee (1993) used a multivariate GARCH in mean model to analyse the markets in Canada, Germany, Japan, the UK and the US. Koutmos and Booth (1995) examined the asymmetric impact of good and bad news on volatility transmission across the New York, Tokyo and London stock exchanges. Kanas (1998) examined the three largest European stock markets of London, Frankfurt and Paris during the period 1984-1993.

[175] For a detailed review of the literature on these studies see Chapter 3.

(1996) are some of the relevant studies in this area. In addition, Wang et al. (2005) investigated return and volatility spillovers from the developed markets of the US and Japan to the three South Asian markets of India, Pakistan and Sri Lanka using a univariate EGARCH model to distinguish the impact of global (the US) and regional (Japan) factors on the emerging markets of the region[176].

One of the recent advances in the study of spillover effects has been the usage of multivariate GARCH models which recognise that the return or volatility of several countries may interact to influence the performance of another market. Chou et al. (1999), Scheicher (2001) and Worthington and Higgs (2004) were among the first who adopted this approach of using a multivariate GARCH model[177]. For example, Chou et al. (1999) investigated the linkages between the stock markets of Taiwan and the US using close-to-open, close-to-close and open-to-close returns for Taiwan's Taikex index and the S&P 500 composite index. The time period for this data ranged from January 1, 1991 to December 31, 1994 and a multivariate GARCH model was used. They uncovered evidence of both return and volatility spillovers from the US market to the Taiwanese market. They concluded that 'US-induced volatility' explained about 12 per cent of the total daily index variability of the Taiwanese stock market.

[176] Wang et al. (2005) excluded the Bangladeshi market from their sample, a market which has been included in the current thesis. In addition, the focus of this thesis is on the regional integration among the South Asian markets. This issue is typically ignored in earlier studies which tend to focus on spillovers from the developed markets of the world.

[177] Some recent studies have focused on the transmission among various sectors inside an economy to investigate internal linkages among various sectors. For example, Harris and Pisedtasalasai (2006) investigated return and volatility spillover effects between the FTSE large and small cap equity indices. Using daily returns data for a period from January 1986 to December 2002 with a constant conditional correlation multivariate GARCH model, they found an asymmetric return and volatility spillover effect between large and small UK equities. Specifically, they discovered a significant positive spillover from the large company share portfolios to the small company share portfolios in the UK which was more pronounced for mature shocks. By contrast, they found no significant spillovers from the portfolio of smaller company shares to the portfolio of larger company securities. In addition, they concluded that information was first incorporated into the prices of large company shares before being impounded into the prices of small company equities. Investigating sector wise transmission of volatility in the US, Hassan and Malik (2007) used daily returns data from January 1, 1992 to June 6, 2005. They employed a multivariate GARCH model and found significant transmissions of shocks and volatility among all sectors included in the study. Hassan and Malik (2007) argued that their findings pointed to the potential cross-market hedging and the possible sharing of information among investors in these sectors. They further reported that 'news' impacting on one sector eventually spread to all sectors because of their interdependence.

In a subsequent European study, Scheicher (2001) investigated the regional and global integration of stock markets in terms of return and volatility shocks for Hungary, Poland and the Czech Republic with the S&P Actuaries World Index; a multivariate GARCH model with a constant conditional correlation assumption was used in this analysis[178]. Daily share price values were used from January 1995 to October 1997. The results revealed that these three Eastern European emerging markets were integrated with the global market in terms of returns only. In particular, today's returns for the Czech index were influenced by yesterday's price changes in Hungary while returns for Hungary were influenced by variations in the global market. Results from the multivariate GARCH model indicated that regional influences explained volatility in the markets. Shocks from the Czech Republic to Poland and from Hungary to the Czech Republic were significant suggesting that regional spillovers existed from some Eastern European stock markets to others. Shocks from volatility in the global index were not transmitted to Hungary, Poland or the Czech Republic; hence, international variability in returns had no effect on the volatility of price changes for these three Eastern European emerging markets.

To allow for time varying variances and covariances among markets, Worthington and Higgs (2004) also examined the spillover of returns and volatility from the Asian developed markets of Hong Kong, Singapore and Japan to the emerging markets of Indonesia, Korea, Malaysia, the Philippines, Taiwan and Thailand. The Baba, Engle, Kraft and Kroner (BEKK) model proposed by Engle and Kroner (1995) was employed using weekly returns data from January 1988 to October 2000. Worthington and Higgs' multivariate GARCH model results indicated that spillover effects were present in both returns and volatility[179]. They further argued that

[178] They assumed a constant conditional correlation in their model, which is unrealistic because several studies have documented that correlations are time varying (Li and Majerowska, 2008).

[179] They reported that returns in Hong Kong, Indonesia and Korea were influenced by lagged shocks to returns in the Japanese market. The mean return for the Thai market was influenced by the lagged returns of the markets in Hong Kong, Indonesia, Korea, the Philippines and Singapore. Among the sample of nine countries

the influence of a stock market's own past volatility on current variability was greater than the volatility spillover from other markets. The coefficient values for own market volatility spillover ranged from 0.0824 for the Korean market to 0.0969 for the Philippines. The GARCH set of parameters also indicated that cross-market volatility spillover was highly significant. For example, the persistence of lagged volatility from the Hong Kong market ranged from 0.79 for Indonesia to 0.85 for Taiwan.

Another theme which is apparent in the literature is the growing complexity of the models used to examine spillover. While early studies employed simple GARCH models, more recent investigations have used models which incorporate multivariate GARCH effects into the analysis such as the GARCH-BEKK model ( Li, 2007; Malik and Hammoudeh, 2007; Li and Majerowska, 2008; Joshi, 2011). Most of these studies have investigated return and volatility spillovers in the major emerging markets of East Asia and Central Europe. For example, Li (2007) investigated the linkages between the two emerging stock markets of China (Shanghai and Shenzhen) and the developed markets of Hong Kong and the US. A multivariate GARCH-BEKK model was employed using daily data over a period from January 4, 2000 to August 17, 2005. His results indicated no evidence of a spillover effect between the Chinese and the US markets in terms of both returns and volatility. A unidirectional volatility spillover was found from Hong Kong to both Chinese markets. These findings indicated that the Chinese stock markets were integrated with the developed market of Hong Kong, rather than the developed market of the US. The study further showed that there was a bidirectional shock spillover between the stock markets of Shanghai and Shenzhen. The coefficient values for the GARCH effect were 0.3978, 0.5054 and 0.9781 for

considered, Japan, Korea and Thailand had the greatest influence with higher coefficient values in the mean equations. The variance-covariance equations indicated that own and cross market shocks were present; thus there was evidence of volatility spillover. Their results indicated that own market volatility spillover in all countries was higher than cross-market volatility indicating a strong ARCH effect in the data.

own and cross-markets, indicating highly significant volatility spillovers between the two exchanges.

Investigating the linkages between the emerging stock markets of the Central and Eastern European countries of Poland and Hungary, and the developed markets of Germany and the US within a multivariate framework, Li and Majerowska (2008) used the VAR-GARCH-BEKK model[180]. Daily stock index data were analysed from January 1, 1998 to December 30, 2005 to investigate both return and volatility spillovers among the markets. Their results indicated that there was a unidirectional return spillover from the S&P 500 to the indices of Warsaw, Budapest and Frankfurt. A unidirectional return spillover was also discovered from Frankfurt to Budapest and from Budapest to Warsaw. A bidirectional return spillover was found between Frankfurt and Warsaw. The study reported a unidirectional volatility spillover from Frankfurt and the S&P 500 indices to the indices of Warsaw and Budapest. A bidirectional volatility spillover was found between the Frankfurt and S&P 500 and between Warsaw and Budapest. Li and Majerowska (2008) concluded that these two emerging markets of Central and Eastern Europe were linked to the developed markets of Frankfurt and the S&P 500 in terms of both return and volatility spillovers. The two emerging markets were also linked with each other although the direction of the spillover differed for returns and volatility.

More recently, Joshi (2011) investigated return and volatility spillovers among the Asian markets of India (BSE), Hong Kong (Hang Seng), Japan (N225), China (SSE), Indonesia (JKSE) and Korea (KSII) using a multivariate framework. Joshi (2011) found both a unidirectional and bidirectional return spillover among the markets[181]. A detailed analysis of

[180] The markets examined in the study were Warsaw (WIG), Budapest (BUX), Frankfurt (DAX), and the US (S&P 500).

[181] The unidirectional return spillover was from the Hang Seng index to the BSE index, from the Hang Seng index to the JKSE index, and from the N225 index to the Hang Seng index.

the volatility spillover revealed a bidirectional transmission of shocks between the BSE and the N225, the SSE and the BSE, the Hang Seng and the SSE, the Hang Seng and the KSII and between the JKSE and the KSII. In addition, a bidirectional volatility spillover was found between the Indian market as well as the Hang Seng index and the markets of almost all other Asian countries examined[182].

From the literature, it is evident that there is less focus on market linkages from the perspective of volatility spillovers. Those studies that have been conducted in this area have tended to investigate linkages among various regional and international markets using return (mean equation) data. Studies which have investigated return and volatility transmission among the markets with a multivariate GARCH framework have mostly ignored South Asian emerging stock markets. In addition, studies that have investigated linkages in the South Asian region are fairly dated. To the best of the researcher's knowledge, no study has focused exclusively on the South Asian markets during a recent time frame and used advanced econometric techniques such as those employed in this thesis. The current chapter intends to fill a gap in our knowledge and contribute to the literature on the linkages among four South Asian markets by using the VAR-GARCH-BEKK model proposed by Engle and Kroner (1995). This multivariate GARCH approach was selected for the current chapter due to its ability to examine linkages for more than two countries in terms of both return and volatility. In addition, it should shed some light on the nature of the linkages already documented in Chapter 5 based on cointegration analysis. The BEKK model is used in order to allow the variances to change over time and to examine whether any cross-market volatility spillover effects are present; such effects are omitted in the studies using cointegration analysis.

[182] Bidirectional volatility spillover was found between the BSE and the Hang Seng, the N225, the JKSE and the KSII indices and between the Hang Seng and the N225, JKSE, and KSII indices. Also, bidirectional volatility spillover was uncovered between the N225 with the SSE, the JKSE, and the SSE.

### 7.3: Data and Preliminary Analysis

Weekly data are used for the four South Asian emerging stock markets of Bangladesh, India, Pakistan and Sri Lanka. In particular, weekly returns were computed for the four South Asian markets as the first differences of the natural logarithm of the stock indices, the formula was used as in equation (5.1). The use of weekly data was preferred over daily and monthly data to mitigate against the potential effects of any noise which might be present in the daily prices and to avoid any data shortage problem which might arise with monthly values (Chuang et al., 2007)[183]. The period under examination ranges from January 1993 to December 2010 - a total of 938 observations. To investigate the effect of September 11, 2001 on the linkages in the South Asian region, the entire period was divided into two sub-periods; pre- and post-September 11, 2001. A detailed analysis of the data is provided in Chapter 5. All return series were found to be leptokurtic (having fat tails) and therefore, the return series in all four markets were examined for the existence of autoregressive conditional heteroscedastcity using the test suggested by Engle (1982)[184]. The return series in all four markets exhibited evidence of ARCH effects and therefore, estimation via a GARCH model was deemed appropriate. A brief discussion of the data as it relates to the analysis of the current chapter now follows.

In the previous chapter, the econometric models employed assume that any relationships are linear when estimating the parameters. However, it is likely that many financial relationships (such as, for example, an investors' willingness to trade off return and risk) are non-linear

[183] Roca (1999) argued that the use of daily data gives rise to problems of noise, nonsynchronous trading and day-of-the week effects. Tay and Zhu (2000) reported that they used weekly data to avoid potential problems with nonsynchronous trading and stale quotes which were possible reasons for the inconsistent results in earlier studies.

[184] The ARCH test proposed by Engle (1982) suggests that the residuals are first squared from the return series which are then regressed on constant and own lagged values. The statistics for the ARCH effect is calculated as $TR^2$ where $T$ is the number of observations and $R^2$ is the coefficient of determination from the lagged squared error regression. The null hypothesis is that there is no ARCH effect in the data. All the p-values for the four markets were less than 0.05, suggesting the presence of ARCH in the South Asian stock markets return series. The results for the test are reported in Appendix 7.4.

(Campbell et al., 1997) such that variance is time-varying and hence volatility spillovers should be considered. The implications of return and volatility spillovers for the EMH were discussed in Chapter 3 of this thesis.

In addition, linear models are unable to explain a number of important features which are often present in financial time series, such as leptokurtosis, volatility clustering and leverage effects; these traits are common to most financial data (Brooks, 2008). The data used in the current thesis exhibit these features (see Table 5.1 and Figures 7.1-7.4) and thus further supports the use of a non-linear GARCH model for the analysis undertaken.

Figures 5.1 to 5.4 in Chapter 5 present the time series plots of the price levels for the four indices; the weekly variation in the different markets is apparent from these figures[185]. A visual inspection of the figures reveals that the indices of the two relatively large stock markets of India and Pakistan follow similar paths. The stock markets of Bangladesh and Sri Lanka also exhibit similar patterns- especially in more recent years. From the figures it is apparent that the Bangladeshi stock market suffered from some difficulties in 1996 due to internal issues within the country, as discussed in Chapter 5[186]. The downturn in the global economy during 2007-2008 resulted in a fall in all markets, although the magnitude of this decline was different from one country to another. Specifically, the Bangladeshi market seems to have been relatively unaffected by the US credit crisis of 2009; by contrast, the other markets witnessed sizeable falls during this year.

[185] To avoid repetition of the same figures, they are only indicated in Chapter 5.

[186] According to Solaiman (2006), in 1996, the political party that led the country to independence in 1971 came into power after 21 years in opposition. The general public had high expectations of the newly elected government in terms of political stability and good governance. As a result, share prices multiplied by nearly four times from July to November 1996. Market capitalisation of the DSE appreciated by 265 per cent and increased from eight to 20 per cent of GDP. These irrational stock market movements were short-lived and debacle started in the middle of November 1996. The index went down dramatically from 3648.75 on November 1, 1996 to 486.62 points on April 21, 1999.

Figures 7.1 to 7.4 display the returns of four index series computed as the first difference of the natural logarithm of the weekly equity indices. The Indian and Pakistani stock markets show higher levels of volatility relative to the two smaller markets of Bangladesh and Sri Lanka during the crisis period in 2008. The Bangladeshi stock market exhibits a higher level of volatility during 1996-1997 when the market was rocked by a 'shares scam' at that time (see Chapter 5 for more details). The high levels of volatility in these markets is consistent with the view of Harvey (1995) who argued that emerging markets in Europe, Latin America, Asia, the Middle East and Africa exhibit larger price changes than their more developed counterparts. In addition, the volatility in the four markets shows some evidence of clustering; for example, high (low) volatility in one period is followed by high (low) volatility in a subsequent period. The high (low) volatilities in the four markets are evident from Figures 7.1 to 7.4. For example, in Bangladesh, higher volatility in November 1996 is followed by higher volatility in October 1996. In the Indian market, volatility clusters are evident in the years 1997, 2000 and 2008. In the Pakistani market, there are high (low) levels of volatility in mid-1998 and early-2009. In the Sri Lankan market, high (low) levels of volatility are evident in 2001, 2008 and early-2009. According to Li and Majerowska (2008) and Joshi (2011), when volatility clustering occurs simultaneously in emerging market stock market indices, it should be modelled in a systematic fashion[187].

[187] To test for non-linearity, the Autoregressive Conditional Heteroscedasticity (ARCH) Lagrange Multiplier (LM) test statistic introduced by Engle is used (Engle, 1982). An autoregressive (AR) model is fitted to each index return series and tested for the presence of ARCH effects. The test statistic has a $\chi^2$ distribution under the null hypothesis of no ARCH effects. Engle's ARCH test (Engle, 1982) indicates whether each market's unexpected returns depend strongly on their past values and therefore whether estimation using a GARCH model is appropriate (Malik and Ewing, 2009). The results of the test are reported in Appendix 7.4 of this thesis.

**Figure 7.1: Bangladesh Return Series**

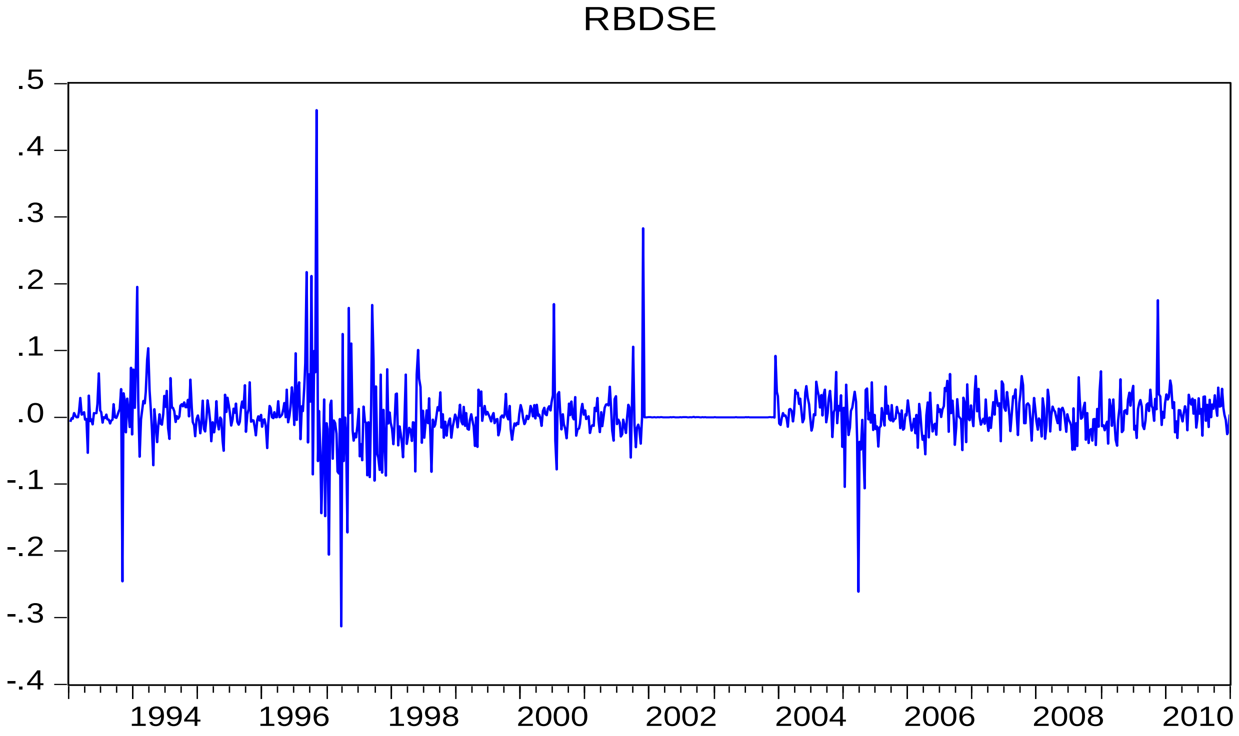



**Figure 7.2: India Return Series**

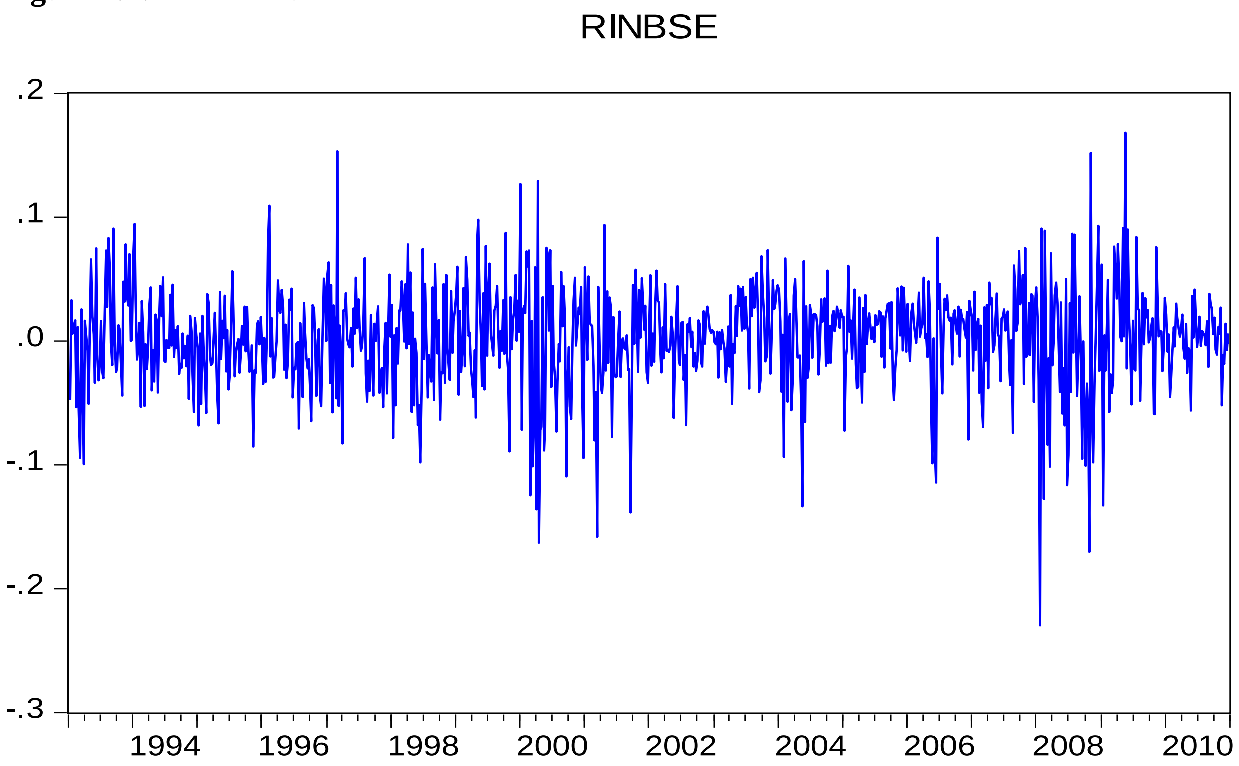


**Figure 7.3: Pakistan Return Series**

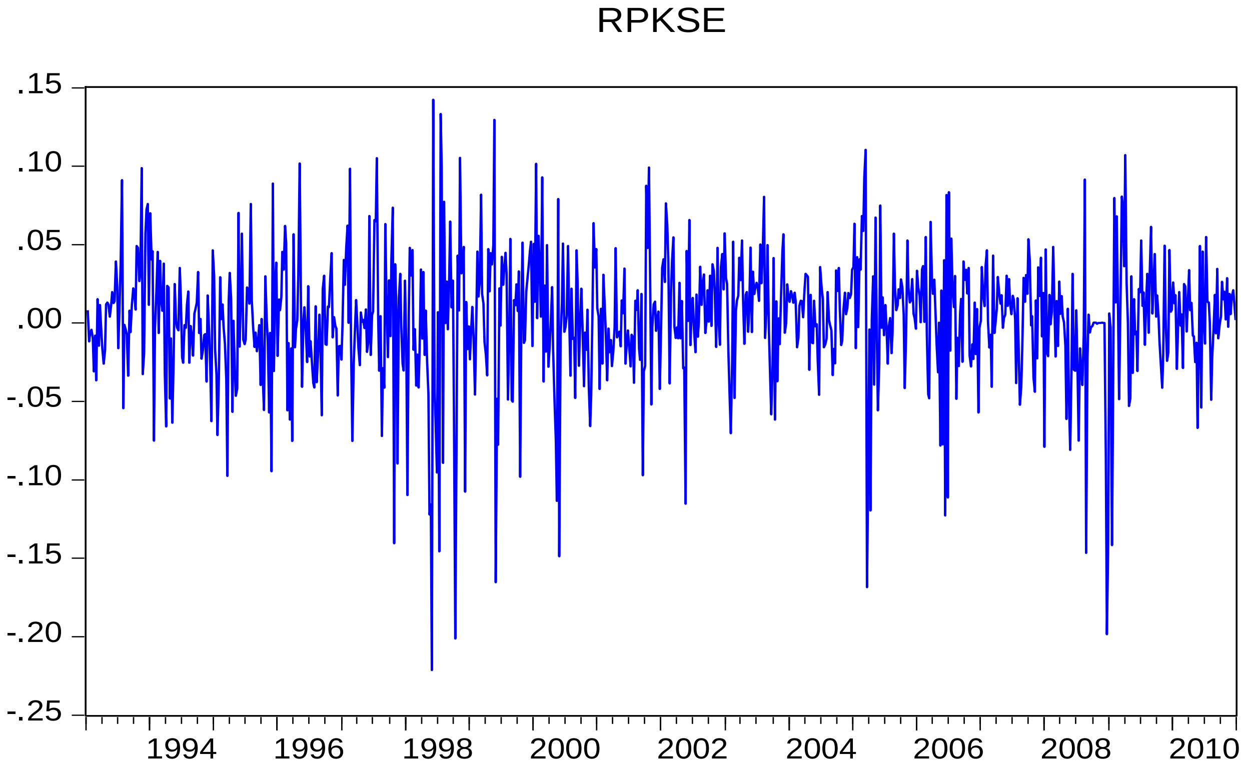
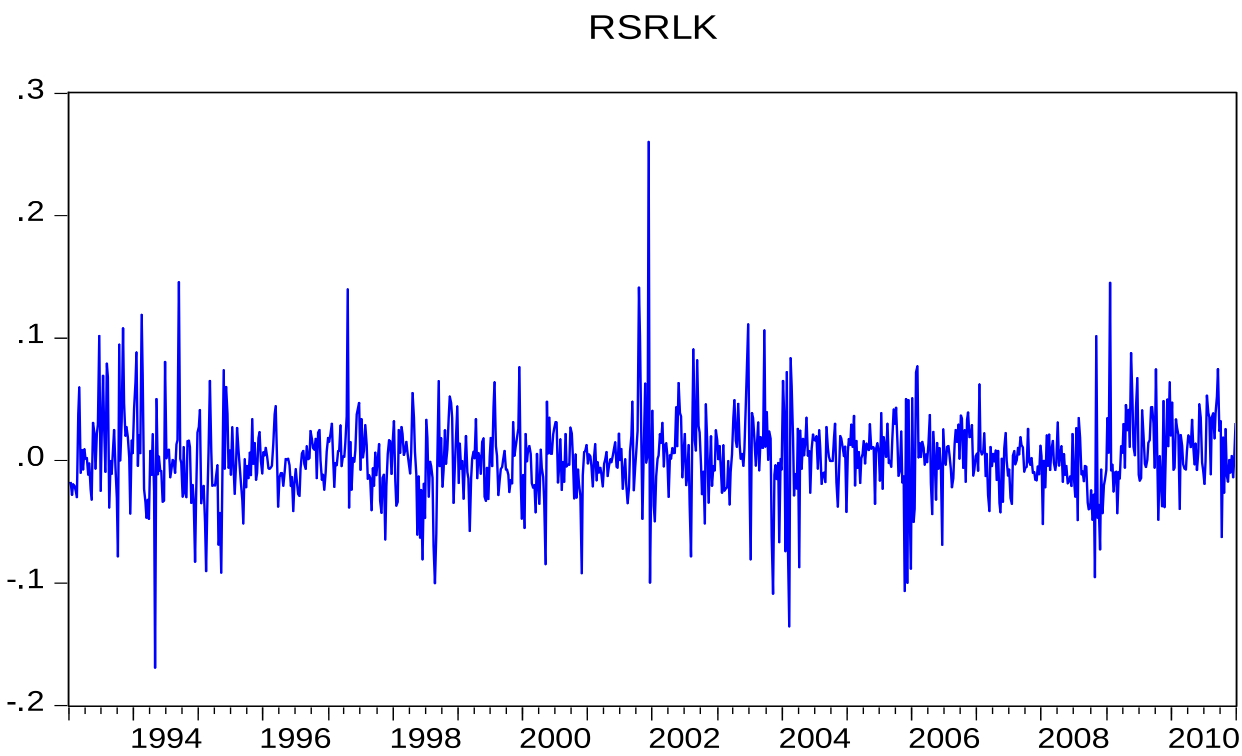



**Figure 7.4: Sri Lanka Return Series**




Figures. 5.5 – 5.8. Returns of the stock indices during January 1993 and December 2010. The stock indices of BDSE, INBSE, PKSE and SRLK correspond, respectively, to the stock markets of Bangladesh, India, Pakistan and Sri Lanka.

The descriptive statistics in Chapter 5 summarised the mean, the unconditional volatility (as measured by the standard deviation), skewness, kurtosis and the Jarque-Bera statistics. The stock indices of India and Pakistan revealed significant evidence of negative skewness, indicating that large negative returns were more common than large positive price changes. In contrast, the Bangladeshi and Sri Lankan stock market indices exhibited signs of significant positive skewness. All the return series are leptokurtic, having significantly higher peaks and fatter tails than one would expect with a normal distribution; the kurtosis statistics are greater than three in all of the four markets. A GARCH model is capable of dealing with data which have these features. When the series are modelled within a GARCH framework, the non-zero skewness statistics indicate that an ARCH order higher than one is required in the conditional variance equation (Li, 2007; Li and Majerowska, 2008; Joshi, 2011). As a result, a multivariate GARCH (1,1) model may be preferred to an ARCH(p) model when examining volatility spillover effects for the sake of parsimony.

## 7.4: Empirical Results

The equations estimated are (i) the mean equation (Equation [4.23] on page 129); (ii) the variance equations (Equations [4.27] to [4.30] on page 131); and (iii) the covariance equations (Appendix 7.7, pages 271-77). These equations are estimated to analyse the linkages among the markets in greater depth (from both a return and volatility perspective). In addition, the direct and indirect effects of volatility spillovers are examined by employing both variance and covariance equations. Specifically, the coefficients in the variance equations and the coefficients in the covariance equations permit a test of whether direct and indirect spillover effects are present. The parameters of interest are those in the return and volatility equations based on a series' own as well as the cross-market returns in the region.

Some studies have attempted to investigate the impact of the terrorist attack on the US World Trade Centre in September 2001 on return and volatility; their analysis has been performed for a single South Asian stock market (Ahmed and Farooq, 2008; Suleman, 2012)[188] and for several international markets (Charles and Darne, 2006; Hammoudeh and Li, 2008; Meric et al., 2008; Nikkinen et al., 2008[189]). However, they have either focused on a specific set of countries other than those in South Asia or they have only investigated volatility shifts in individual stock markets and ignored volatility spillovers across several stock markets. The current investigation attempts to overcome these difficulties by investigating the effect of the 9/11 terrorist attack in the US on stock markets in the South Asian region using the MGARCH-BEKK model and a relatively up-to-date, large data set.

Investigations of transmission mechanisms among stock markets from the perspective of return and volatility are important for a number of reasons. First, the finding of return spillovers (and changes in spillovers) among markets potentially represents evidence against market efficiency (Harris and Pisedtasalasai, 2006). In an efficient market, all available historical information cannot be used to predict current and future returns. Therefore, a finding of a significant spillover represents prima facia evidence of inefficiency. Second, an investigation of transmission mechanisms before and after 9/11 may help in choosing assets to be included in investment portfolios. It may highlight how the composition of portfolios need to change following a global event such as the 9/11 attack on the World Trade Centre in New York. Finally, an examination of changes in volatility transmission may help in asset pricing models which rely on estimates of conditional volatility; for example, some option

[188] Using a univariate EGARCH model, Ahmed and Farooq (2008) reported a change in the leverage effect on the volatility of KSE-100 index returns after 9/11 while Suleman (2012) documented a shift in overall volatility after that date. Ahmed and Farooq (2008) argued that the terrorist attacks resulted in some unexpected benefits for Pakistan (e.g. a surge in remittances, an increase in export quotas for textiles to the EU and the US as well as debt rescheduling). This may have improved firm performance, increased the liquidity of the stock exchange, and made the market more volatile (Suleman, 2012).

[189] Nikkinen et al. (2008) investigated the impact of 9/11 on the national stock markets of 53 countries including India, Pakistan and Sri Lanka. However, they evaluated the effect of 9/11 on a regional basis rather than on individual countries.

pricing, portfolio optimisation and hedging models use estimates of conditional variance as an input (Hassan and Malik, 2007). The mean and variance –covariance equations were estimated simultaneously by the maximum likelihood method[190]. The stock exchange indices of Bangladesh (BDSE), India (INBSE), Pakistan (PKSE) and Sri Lanka (SRLK) were denoted as 1, 2, 3, and 4, respectively. The matrix $\Gamma$ in the mean equation was first estimated. To look for a relationship in terms of return spillover across the four markets, parameters captured in equation (4.23, page 129) were measured by $\gamma_{ij}$.

**Table 7.1: Estimated Coefficients from the Mean Equation**

| Return | BDSE | INBSE | PKSE | SRLK |
|---|---|---|---|---|
| μ | 0.1342* | 0.3094* | 0.3292* | 0.1459 |
| $\gamma$ ($i$,1) | 0.1881* | -0.0717* | -0.0241 | -0.0814* |
| $\gamma$ ($i$,2) | 0.0719* | 0.0100 | 0.1113* | 0.0264 |
| $\gamma$ ($i$,3) | -0.0014 | 0.0662* | 0.1152* | 0.0481* |
| $\gamma$ ($i$,4) | -0.0397* | 0.0402 | 0.0437 | 0.1777* |

An * indicates significance at the five per cent level. BDSE, INBSE, PKSE and SRLK represent Bangladeshi, Indian, Pakistani and Sri Lankan stock market indices, respectively. $i$ = 1, 2, 3 and 4 stands for BDSE, INBSE, PKSE, and SRLK, respectively.

Table 7.1 reports the results from the mean equation (equation 4.23). It shows the return spillovers in a county's own market as well as in the three other markets of the South Asian region investigated. The diagonal parameters $\gamma(1,1)$, $\gamma(3,3)$ and $\gamma(4,4)$ are statistically significant. These imply that the returns of the Bangladeshi, Pakistani and Sri Lankan indices depend on their own past return values for up to lag one. By contrast, the insignificant diagonal parameter $\gamma(2, 2)$ indicates that the returns of the Indian market do not depend on

[190] Initially the estimation was done using Eviews version 7, but later it was realised that this software did not provide all of the coefficients for the cross-market spillovers in the variance covariance equation. The Regression Analysis of Time Series (RATS) version 6 was then used to estimate all the required coefficients in both the mean and variance covariance equations. The results from Eviews are reported in Appendices 7.5 and 7.6.

their own past values. The cross-market return linkages are represented by the off-diagonal parameters and a number of patterns are evident in the findings of Table 7.1. First, three pairs of off-diagonal parameters are statistically significant at the five per cent level: $\gamma(1, 2)$ and $\gamma(2, 1)$; $\gamma(1, 4)$ and $\gamma(4, 1)$; $\gamma(2,3)$ and $\gamma(3, 2)$; indicating that there are bidirectional return spillovers between the stock markets of Bangladesh and India, Bangladesh and Sri Lanka and India and Pakistan, respectively. The parameter $\gamma(4, 3)$ is statistically significant at the five per cent level, whereas its counterpart $\gamma(3, 4)$ is not significant, implying that there is a unidirectional influence in the returns between the stock markets of Pakistan and Sri Lanka. The results from the mean equation in Table 7.1 are in agreement with the findings in Chapter 5, indicating that equity returns in the South Asian stock markets are predictable from the historical share prices in their own, as well as from other markets of the region; this result calls the weak form of the EMH into question. For example, Harris and Pisedtasalasai (2006, p.1556) stated that:

> "In an efficient market, and in the absence of time-varying risk premia, it should not be possible to forecast the returns of one stock using the lagged returns of another stock. The finding that there are spillover effects in returns implies the existence of an exploitable trading strategy and, if trading profits exceed transaction costs, potentially represents evidence against market efficiency".

**Table 7.2: Multivariate GARCH Model for Four South Asian Markets: Entire Period**

| **Ind var** | $h_{11,t}$ | $h_{22,t}$ | $h_{33,t}$ | $h_{44,t}$ | $h_{21,t}$ | $h_{31,t}$ | $h_{41,t}$ | $h_{23,t}$ | $h_{24,t}$ | $h_{34,t}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon^2_{1,t-1}$ | 0.72* | 0.01 | 0.02* | 0.04* | -0.06 | -0.11* | -0.17* | 0.01 | 0.02 | 0.03 |
| $\varepsilon^2_{2,t-1}$ | 0.00 | 0.04* | 0.00 | 0.01 | -0.00 | -0.00 | 0.00 | 0.01 | -0.02* | -0.01 |
| $\varepsilon^2_{3,t-1}$ | 0.01* | 0.00 | 0.23* | 0.00 | 0.00 | 0.05* | -0.01 | 0.02 | -0.00 | -0.03* |
| $\varepsilon^2_{4,t-1}$ | 0.00 | 0.01 | 0.00 | 0.08* | -0.00 | -0.00 | -0.00 | 0.00 | 0.03* | 0.00 |
| $\varepsilon_{1,t-1}\varepsilon_{2,t-1}$ | 0.02 | 0.03 | 0.01 | -0.05 | -0.17 | -0.04 | 0.10 | 0.03 | 0.03 | -0.01 |
| $\varepsilon_{1,t-1}\varepsilon_{3,t-1}$ | 0.19* | -0.00 | -0.13 | 0.02 | 0.02 | 0.39* | -0.08 | -0.04 | -0.00 | -0.09* |
| $\varepsilon_{1,t-1}\varepsilon_{4,t-1}$ | -0.00 | -0.01 | -0.00 | -0.11* | 0.09 | 0.00 | 0.24 | -0.01 | -0.04 | -0.04 |
| $\varepsilon_{2,t-1}\varepsilon_{3,t-1}$ | 0.00 | -0.01 | -0.04 | -0.01 | -0.02 | 0.00 | 0.01 | -0.10 | 0.02 | 0.06 |
| $\varepsilon_{2,t-1}\varepsilon_{4,t-1}$ | -0.00 | -0.04* | -0.00 | 0.07* | 0.00 | 0.00 | 0.00 | -0.01 | -0.04* | -0.01 |
| $\varepsilon_{3,t-1}\varepsilon_{4,t-1}$ | -0.00 | 0.01 | 0.00 | 0.03* | 0.01 | -0.00 | 0.03 | 0.05 | 0.00 | 0.13 |
| | | | | | | | | | | |
| $h_{11,t-1}$ | 0.65* | 0.00 | 0.01 | 0.00 | 0.01 | -0.07 | 0.02 | -0.00 | 0.00 | -0.00 |
| $h_{22,t-1}$ | 0.00 | 0.92* | 0.02* | 0.01 | 0.01 | 0.00 | -0.00 | 0.14* | -0.04* | -0.01 |
| $h_{33,t-1}$ | 0.00 | 0.01 | 0.45* | 0.00 | 0.00 | 0.02 | -0.00 | 0.05 | -0.00 | -0.00 |
| $h_{44,t-1}$ | 0.00 | 0.18* | 0.00 | 0.27* | -0.00 | -0.00 | -0.00 | 0.00 | 0.22* | 0.00 |
| $h_{12,t-1}$ | 0.02 | 0.02 | -0.02 | -0.00 | 0.77 | 0.12 | -0.03 | -0.08 | 0.02 | 0.01 |
| $h_{13,t-1}$ | -0.03 | -0.00 | 0.11 | 0.00 | -0.06 | -0.54* | 0.00 | 0.00 | -0.00 | -0.01 |
| $h_{14,t-1}$ | 0.01 | -0.01 | 0.00 | -0.02 | -0.34 | -0.00 | -0.42 | 0.03 | -0.01 | 0.04 |
| $h_{23,t-1}$ | -0.00 | -0.13 | -0.20* | -0.00 | -0.02 | -0.01 | 0.00 | -0.65 | 0.01 | 0.03 |
| $h_{24,t-1}$ | 0.00 | -0.81* | -0.00 | 0.04* | 0.00 | 0.00 | -0.01 | -0.07 | -0.48* | -0.08* |
| $h_{34,t-1}$ | -0.00 | 0.06 | 0.01 | -0.00 | 0.01 | -0.01 | 0.01 | 0.28 | 0.04 | 0.35 |

$h_{ii,t}$ denote the conditional variances for the four South Asian stock markets of Bangladesh, India, Pakistan and Sri Lanka. Columns $h_{ij,t}$ represent the conditional covariances between the markets. The Multivariate GARCH model uses BEKK parameterisations. An * indicates that the coefficients are significant at the five per cent level.

The estimated results from the variance – covariance equation are reported in Table 7.2[191]. In particular, results for each element in matrix *A* and matrix *G* are split into their respective coefficients for each of the four markets and for the cross-market spillovers of shocks ($\varepsilon_{i,t-1}\varepsilon_{j,t-1}$ for $i \neq j$) and volatility ($h_{ij,t-1}$ for $i \neq j$), to investigate the inter-relationships among these markets in greater depth. The four emerging stock markets of South Asia

[191] The four conditional variance equations are reported in Chapter 4 on Methodology and Methods whereas the covariance equations are reported in Appendix 7.7 of this thesis.

(Bangladesh, India, Pakistan and Sri Lanka) are represented by 1, 2, 3 and 4, respectively. The results are estimated for the entire period and for the two sub-periods of pre- and post-September 2001 by employing a multivariate GARCH model with BEKK parameterisation. The symbols $h_{ii,t}$ describe the conditional variance equation for each of the four markets at time $t$ whereas the symbols $h_{ij,t}$ represent the conditional covariance. The error term '$\varepsilon$' in each model represents the effect of 'news' (unexpected shocks) in each market and with other markets. For example, '$\varepsilon^2_{1,t-1}$' represent the deviations from the mean due to some unanticipated event in the Bangladeshi market. The cross values of the error terms represent interactive effects of shocks in two markets at time $t-1$. For example, the coefficient of $\varepsilon_{1,t-1}\varepsilon_{2,t-1}$ represent interactive effects of shocks in Bangladesh and India.

Table 7.2 reports the results for the entire period, whereas Tables 7.3 to 7.5 reveals the results for the two sub-periods. In particular, the first four columns of each table reports the variance equations for the four markets, the remaining six columns represent co-variance equations coefficients. In addition, the first panel of 10 rows represents own and cross-market shock transmissions among the markets whereas the bottom panel of 10 rows indicates own and cross-market volatility coefficients. A visual inspection of Table 7.2 reveals that the coefficient values of '$\varepsilon^2_{i,t-1}$' are significant for all four markets of the region. These results imply that own past 'news' values have significant effects on the volatility of Bangladesh, India, Pakistan and Sri Lanka, respectively. The coefficient values for the lagged variance terms '$h_{ii,t-1}$' are also significant for all four markets indicating a strong GARCH (1, 1) process driving the conditional variances of all the market indices. These results indicate that all four markets are directly affected by the 'news' and volatility generated within their own markets. Volatility of returns in week $t$ depends on volatility in the previous week. The overall persistence of stock market volatility as measured by the coefficient term of $(h_{ii,t-1})$ is the highest for India (0.92) and the lowest for Sri Lanka (0.27).

The significant values of the coefficients of $(\varepsilon_{i,t-1}\varepsilon_{j,t-1}$ and $h_{ij,t-1})$ indicate that cross-market spillovers of shocks and volatility exist between the markets. First, the Bangladeshi market is affected by the shocks and volatility generated by its own market. In addition, the Bangladeshi market is significantly affected by shocks in the Pakistani market both directly and indirectly as indicated by the significant coefficient terms (i.e.$\varepsilon^2_{3,t-1} = 0.01$, $\varepsilon_{1,t-1}\varepsilon_{3,t-1} = 0.019$). This indicates strong linkages between the two markets in terms of shocks to the stock markets.

Second, the results indicate that the volatility in the Indian market is affected by the Sri Lankan market in terms of both the transmission of 'news' and volatility; the coefficients are $(\varepsilon_{2,t-1}\varepsilon_{4,t-1}$ at -0.04 and $h_{24,t-1} = -0.81)$. These findings indicate that the conditional variance of one market index depends on the past volatility of the other market index, implying linkages between the two markets.

Third, 'news' in the Bangladeshi market has a direct effect on the Pakistani market volatility while lagged volatility in India has both a direct and indirect effect on volatility in Pakistan. Fourth, the volatility in the Sri Lankan market is also affected by the past volatility generated in the Indian market and itself (as given by the significant coefficients for $h_{44,t-1}$ and $h_{24,t-1}$). These findings indicate that in terms of cross-market volatility spillover, past volatility shocks in the Indian equity index have effects on the future volatility of the Sri Lankan stock market. These spillovers from the Indian market to the Pakistani and Sri Lankan markets and from Pakistan to the Bangladeshi market is understandable given the relatively strong role played by these two markets in the region. Such a result supports the findings of Li and Majerowska (2008) that discovered unidirectional spillovers from the US market to the three relatively small markets of Warsaw, Budapest and Frankfurt. Li and Majerowska (2008) argued that these unidirectional transmissions were consistent with the 'global centre' hypothesis which suggested that large international financial centres such as the US play a major role in the transmission of information that is macroeconomic in nature.

From the covariance equations represented by the symbols $h_{ij,t}$, it is evident that there are no correlations between the equity markets of Bangladesh and India. However, the Bangladeshi and Pakistani markets are linked through lagged shocks and past correlation as indicated by the coefficient of 0.39 for $\varepsilon_{1,t-1}\varepsilon_{3,t-1}$. Both direct and indirect shock spillovers were found between the two markets indicated by the significant coefficients of $\varepsilon_{1,t-1}^2$, $\varepsilon_{3,t-1}^2$ and $\varepsilon_{1,t-1}\varepsilon_{3,t-1}$, respectively, in the equation $h_{31,t}$. An indirect volatility spillover is also present between the two markets indicated by the significant coefficients for $h_{13,t-1}$ (of 0.54). The Indian market has more of an influence on volatility in the Pakistani and Sri Lankan markets, as indicated by the significant coefficients for volatility in the $h_{23,t}$ and $h_{24,t}$ equations. There are direct and indirect volatility spillovers between the Indian and Sri Lankan markets whereas the Pakistani market is directly affected by the volatility in the Indian market. Thus the volatility of India has an impact on the volatility and covariance of Pakistan and Sri Lanka but not on the Bangladeshi market. These findings are not surprising due to the small size of the Bangladeshi market; there is less trade in Bangladesh with the Indian market relative to the other two markets (see Chapter 2 for details). The covariance between India and Pakistan and between India and Sri Lanka depends on the variance in the Indian market. These findings are understandable because of the influential role played by the Indian market in terms of a dissipation of news from the largest market in the region to its smaller neighbours.

The results indicate that there are linkages among the four South Asian markets of Bangladesh, India, Pakistan and Sri Lanka. These linkages are evident from both the transmission of shocks and volatility among the regional markets. One implication from these linkages is that the expected return of an investment in the South Asian markets could be affected by cross-country risk factors. The evidence suggests that news about risk is transmitted among the regional markets, suggesting fewer benefits from international diversification. In addition, these findings clearly indicate that both the returns and volatility of all four South Asian markets respond to their own past information. Hence, current information about a market remains important for all future predictions of the conditional mean and conditional variance of that market. Overall, the results suggest that there are significant volatility transmissions among all four markets of the South Asian region under investigation. These results further support the findings in Chapter 5 which presented evidence of linkages among the South Asian emerging stock markets based on cointegration analysis.

### 7.5: Sub-Period Analysis

To investigate the transmission of returns and volatility in the four emerging stock markets of South Asia in greater depth, and to be consistent with the results presented in the previous chapters, a sub-period analysis was undertaken; the results for this are discussed in the current section. The two sub-periods were identified on the basis of whether the data are pre- or post-September 2001 as discussed in Chapter 5. Table 7.3 reports the results for the return spillovers for the two sub-periods while Tables 7.4 and 7.5 report the results for the shocks and volatility spillovers for the first and second sub-periods, respectively.

**Table 7.3: Estimated Multivariate GARCH Model Coefficients for the Four Markets: Pre- and Post- September, 2001**

| | **BNG** (***i***=1) | **IND** (***i*** =2) | **PAK** (***i*** =3) | **SRLK** (***i*** =4) |
|---|---|---|---|---|
| **Panel A Pre-September 2001** | | | | |
| μ | 0.0790 | 0.1867 | -0.0103 | -0.0129 |
| γ ($i$,1) | 0.0796 | -0.0446 | -0.0386 | -0.0045 |
| γ ($i$,2) | -0.0147 | 0.0118 | 0.1162* | 0.0317 |
| γ ($i$,3) | -0.0322 | 0.0261 | 0.0718 | 0.0706* |
| γ ($i$,4) | -0.0378 | 0.0738 | 0.1574* | 0.2487* |
| **Panel B Post-September 2001** | | | | |
| μ | 0.4418* | 0.5320* | 0.8445* | 0.4065* |
| γ ($i$,1) | 0.2001* | -0.1328* | -0.0768 | -0.0658 |
| γ ($i$,2) | -0.0201 | -0.0109 | 0.0366 | 0.0408 |
| γ ($i$,3) | 0.0597 | 0.1069* | -0.0745 | 0.0543 |
| γ ($i$,4) | -0.0378 | 0.0143 | 0.0177 | 0.1534* |

An * indicates significance at the five per cent level. BDSE, INBSE, PKSE and SRLK represent the Bangladesh, India, Pakistan and Sri Lanka stock market indices, respectively. $i$ = 1, 2, 3 and 4 stands for BDSE, INBSE, PKSE, and SRLK, respectively.

The top panel of Table 7.3 documents the results for return spillovers from the mean equation for the pre- September 2001 period. In particular, it shows results for own as well as cross-market return spillovers before the cut-off date. The parameters of γ(2,3), γ(3,4), γ(4,3) and γ(4,4) are statistically significant at the five per cent level. This result implies that there are bidirectional return spillovers between Pakistan and Sri Lanka and a unidirectional return spillover from India to Pakistan. In addition, returns in Sri Lanka depend on own lagged returns, as indicated by the statistically significant parameter of γ(4,4) at the five per cent level.

The parameters in the lower part of Table 7.3 for the return spillovers show that the parameters for the own market return transmission are statistically significant for Bangladesh and Sri Lanka at the five per cent level. This result implies that their own previous returns have an influence on the current returns in these markets. The significant parameters of γ(2,1) and γ(2,3) also indicate unidirectional return spillovers from India to Bangladesh and from India to Pakistan, respectively. These unidirectional return spillovers further support the argument that the Indian market dominates the region. Overall, the findings in Table 7.3 suggest that the importance of return spillovers has become more pronounced for India and less important for Pakistan in the post September 11, 2001 period. In addition, the markets of Bangladesh and Sri Lanka seem to have become more segmented in the second sub-period since there are no significant cross-market spillovers affecting the mean return in these two countries.

The estimated results from the time varying variance – covariance equations are reported in Tables 7.4 and 7.5. A visual inspection of Table 7.4 reveals that the coefficient values of '$\varepsilon_{i,t-1}^2$' are significant for all four markets of the region. These results imply that own past 'news' values have a significant effect on the stock market returns of Bangladesh, India, Pakistan and Sri Lanka, respectively. The coefficient values for the variance terms '$h_{ii,t-1}$' are also significant for all four markets indicating a strong GARCH (1, 1) process driving the conditional variances of all the markets indices. These results indicate that all four markets are directly affected by the 'news' and volatility generated within their own markets.

The cross-market spillovers of shocks and volatility are evident from the values of the coefficients of ($\varepsilon_{i,t-1}\varepsilon_{j,t-1}$ and $h_{ij,t-1}$). It indicates that shocks in the Indian and Pakistani markets affect volatility in the Bangladeshi market. In addition, past volatility in the Indian market has an indirect effect on the current volatility of the Bangladeshi market, as shown by the significant coefficient for $h_{12,t-1}$. Volatility in the Indian market is affected by the shocks in the Pakistani market as revealed by the significant coefficient for $\varepsilon_{2,t-1}\varepsilon_{3,t-1}$. The

Pakistani market was only affected to a significant extent by its own past shocks and volatility. The Sri Lankan market was influenced by shocks from the Pakistani market and indirectly influenced by the volatility from the Indian market (see the significant coefficients $\varepsilon_{3,t-1}\varepsilon_{4,t-1}$ and $h_{24,t-1}$) in Table 7.4.

**Table 7.4: Multivariate GARCH Model for Four South Asian Markets: Sub-Period 1**

| **Ind var** | $h_{11,t}$ | $h_{22,t}$ | $h_{33,t}$ | $h_{44,t}$ | $h_{21,t}$ | $h_{31,t}$ | $h_{41,t}$ | $h_{23,t}$ | $h_{24,t}$ | $h_{34,t}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon^2_{1,t-1}$ | 0.84* | 0.01 | 0.01 | 0.01 | -0.10 | -0.08 | -0.07 | 0.01 | 0.01 | 0.01 |
| $\varepsilon^2_{2,t-1}$ | 0.01* | 0.11* | 0.00 | 0.00 | -0.04* | 0.00 | 0.00 | -0.01 | -0.01 | 0.00 |
| $\varepsilon^2_{3,t-1}$ | 0.01* | 0.04 | 0.08* | 0.04 | -0.02 | 0.02* | -0.02 | -0.06* | -0.04 | -0.05* |
| $\varepsilon^2_{4,t-1}$ | 0.00 | 0.02 | 0.01 | 0.08* | -0.00 | 0.00 | -0.00 | -0.01 | 0.04 | 0.03 |
| $\varepsilon_{1,t-1}\varepsilon_{2,t-1}$ | 0.20* | 0.07 | -0.01 | -0.01 | -0.32 | 0.03 | 0.03 | 0.02 | 0.02 | -0.01 |
| $\varepsilon_{1,t-1}\varepsilon_{3,t-1}$ | 0.15* | 0.04 | -0.05 | 0.03 | -0.20 | 0.25 | -0.18 | -0.01 | -0.04 | -0.00 |
| $\varepsilon_{1,t-1}\varepsilon_{4,t-1}$ | -0.02 | -0.03 | 0.00 | -0.04 | 0.13 | 0.09 | 0.26 | -0.00 | -0.04 | -0.02 |
| $\varepsilon_{2,t-1}\varepsilon_{3,t-1}$ | 0.02* | 0.14* | -0.01 | -0.02 | -0.05* | 0.03 | -0.02 | -0.10 | 0.06 | 0.00 |
| $\varepsilon_{2,t-1}\varepsilon_{4,t-1}$ | -0.00 | -0.10 | -0.00 | 0.02 | 0.02 | -0.01 | 0.03 | 0.04 | -0.09 | -0.01 |
| $\varepsilon_{3,t-1}\varepsilon_{4,t-1}$ | -0.00 | -0.06 | 0.00 | 0.10* | 0.01 | -0.01 | 0.02 | 0.06 | -0.08 | 0.09 |
| $h_{11,t-1}$ | 0.47* | 0.00 | 0.00 | 0.00 | 0.01 | -0.05 | 0.01 | -0.00 | 0.00 | -0.00 |
| $h_{22,t-1}$ | 0.02* | 0.04* | 0.05 | 0.07* | 0.03 | 0.03 | -0.04 | 0.04 | -0.05 | -0.06 |
| $h_{33,t-1}$ | 0.01 | 0.01 | 0.86* | 0.03 | 0.01 | 0.07 | -0.01 | 0.09 | -0.02 | -0.16 |
| $h_{44,t-1}$ | 0.02 | 0.25 | 0.01 | 0.13* | 0.08 | 0.02 | -0.06 | 0.06 | 0.18 | 0.04 |
| $h_{12,t-1}$ | 0.19* | -0.00 | -0.03 | -0.01 | 0.13 | 0.15 | -0.19 | -0.02 | 0.02 | 0.02 |
| $h_{13,t-1}$ | -0.11 | 0.00 | 0.13 | 0.01 | -0.07 | -0.63 | 0.12 | 0.02 | -0.00 | -0.03 |
| $h_{14,t-1}$ | -0.21 | 0.01 | 0.02 | 0.01 | -0.34 | -0.07 | -0.25 | 0.04 | -0.01 | 0.03 |
| $h_{23,t-1}$ | -0.02 | -0.04 | -0.43 | -0.09 | -0.03 | -0.15 | 0.05 | -0.20 | 0.06 | -0.03 |
| $h_{24,t-1}$ | -0.04 | -0.19 | -0.05 | -0.20* | 0.09 | -0.05 | 0.09 | -0.14 | -0.21 | -0.30 |
| $h_{34,t-1}$ | 0.02 | 0.10 | 0.22 | 0.03 | 0.05 | 0.15 | -0.06 | 0.47 | -0.12 | 0.36 |

$h_{ii,t}$ denotes the conditional variances for the four South Asian stock markets of Bangladesh, India, Pakistan and Sri Lanka. Columns $h_{ij,t}$ represent the conditional covariances between the markets. The Multivariate GARCH model uses BEKK parameterisations. An * indicates that the coefficients are significant at the five per cent level.

**Table 7.5: Multivariate GARCH Model for Four South Asian Markets: Sub-Period 2**

| **Ind var** | $h_{11,t}$ | $h_{22,t}$ | $h_{33,t}$ | $h_{44,t}$ | $h_{21,t}$ | $h_{31,t}$ | $h_{41,t}$ | $h_{23,t}$ | $h_{24,t}$ | $h_{34,t}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| $\varepsilon^2_{1,t-1}$ | 0.02* | 0.02 | 0.00 | 0.00 | 0.02 | -0.01 | 0.01 | -0.01 | 0.01 | -0.00 |
| $\varepsilon^2_{2,t-1}$ | 0.00 | 0.17* | 0.02* | 0.01* | -0.03 | -0.01 | -0.01 | 0.06* | 0.04 | 0.01* |
| $\varepsilon^2_{3,t-1}$ | 0.06* | 0.00 | 0.49* | 0.01* | 0.01 | -0.17* | 0.02 | -0.02 | 0.00 | -0.06* |
| $\varepsilon^2_{4,t-1}$ | 0.00 | 0.00 | 0.00 | 0.10* | -0.00 | 0.00 | -0.02 | -0.00 | 0.02 | -0.01 |
| $\varepsilon_{1,t-1}\varepsilon_{2,t-1}$ | -0.02 | 0.13 | -0.01 | 0.01 | 0.05 | 0.02 | 0.01 | -0.00 | 0.04 | 0.00 |
| $\varepsilon_{1,t-1}\varepsilon_{3,t-1}$ | 0.07* | 0.01 | 0.08 | 0.01 | 0.04 | -0.11 | 0.03 | -0.11 | 0.02 | -0.05 |
| $\varepsilon_{1,t-1}\varepsilon_{4,t-1}$ | -0.02* | 0.02 | -0.19 | 0.04 | 0.00 | 0.00 | 0.04 | -0.01 | 0.05 | -0.02 |
| $\varepsilon_{2,t-1}\varepsilon_{3,t-1}$ | -0.03 | 0.02 | -0.01* | 0.02 | 0.10 | 0.08 | 0.02 | -0.29 | 0.04 | -0.06* |
| $\varepsilon_{2,t-1}\varepsilon_{4,t-1}$ | 0.01 | 0.04 | 0.06 | 0.07* | -0.03 | 0.01 | -0.03 | -0.01 | 0.14 | 0.04 |
| $\varepsilon_{3,t-1}\varepsilon_{4,t-1}$ | -0.03* | 0.00 | 0.00 | 0.06* | 0.01 | 0.04 | 0.07 | 0.04 | 0.01 | -0.23 |
| | | | | | | | | | | |
| $h_{11,t-1}$ | 0.33* | 0.60* | 0.11 | 0.04* | -0.44* | 0.19 | -0.12 | -0.26 | 0.16 | -0.07 |
| $h_{22,t-1}$ | 0.09* | 0.59* | 0.01 | 0.00 | 0.24* | 0.03 | -0.00 | 0.07 | -0.01 | -0.00 |
| $h_{33,t-1}$ | 0.03 | 0.12* | 0.33* | 0.00 | -0.06 | 0.11 | 0.00 | 0.20* | 0.01 | 0.01 |
| $h_{44,t-1}$ | 0.00 | 0.04 | 0.00 | 0.75* | 0.01 | -0.00 | -0.03 | -0.01 | -0.18 | 0.05 |
| $h_{12,t-1}$ | 0.35* | 0.97* | 0.06 | 0.00 | 0.21* | 0.15 | -0.07 | 0.19 | -0.16 | -0.02 |
| $h_{13,t-1}$ | -0.21 | 0.53* | -0.38 | 0.01 | -0.05 | -0.39 | 0.02 | 0.33 | 0.08 | 0.11 |
| $h_{14,t-1}$ | -0.03 | 0.32 | 0.04 | -0.35* | -0.09 | 0.02 | 0.50 | -0.11 | -0.62 | 0.28 |
| $h_{23,t-1}$ | -0.11 | -0.53* | 0.10 | 0.00 | -0.24 | -0.19 | -0.00 | -0.48 | -0.01 | 0.00 |
| $h_{24,t-1}$ | -0.02 | -0.31* | 0.01 | -0.01 | -0.09 | 0.01 | 0.26 | -0.03 | 0.67 | 0.08 |
| $h_{34,t-1}$ | 0.01 | 0.14 | -0.06 | -0.03 | 0.05 | 0.01 | -0.16 | 0.10 | -0.29 | -0.50 |

$h_{ii,t}$ denotes the conditional variances for the four South Asian stock markets of Bangladesh, India, Pakistan and Sri Lanka. Columns $h_{ij,t}$ represent the conditional covariances between the markets. The Multivariate GARCH model uses BEKK parameterisations. An * indicates that the coefficients are significant at the five per cent level.

Table 7.5 reports the results for the transmission of shocks and volatility for the second sub-period 2002 - 2010. A visual inspection of Table 7.5 reveals that the coefficient values for '$\varepsilon^2_{i,t-1}$' are significant in all four markets of the region. These results imply that own past shocks have significant effects on the stock market returns of Bangladesh, India, Pakistan and Sri Lanka, respectively. The coefficient values for the variance terms '$h_{ii,t-1}$' are also significant for all four markets indicating a strong GARCH (1, 1) process driving the conditional variances of all the markets indices. These results indicate that all four markets are directly affected by the 'news' and volatility generated within their own markets.

The significant coefficients in the variance equation for the Bangladeshi market indicates that its volatility is affected directly and indirectly by volatility shocks in the Indian market ($h_{22,t-1}$ and $h_{12,t-1}$). This implies that during the second sub-period, past volatility in the Indian market had a significant impact on current volatility in the Bangladeshi market. An innovation in the Pakistani market also affected the Bangladeshi market both directly and indirectly. Past shocks in the Indian market had a direct effect on the Indian market. In addition, the Indian market was affected by volatility transmission with all three emerging stock markets of the region as indicated by the significant coefficients in the variance equation for the Indian market. This implies that in the most recent period interactions among the markets increased significantly. In particular, the coefficient for volatility transmission is higher between Bangladesh and India (0.97) in the second sub-period. Shocks in the Pakistani market were directly and indirectly affected by shocks in the Indian market. However, volatility in the Pakistani market was affected only by its own past volatility. The Sri Lankan market was mainly affected by shocks in the Indian and Pakistani markets and volatility changes in the Bangladeshi market in the second sub-period. The significant coefficients for volatility ($h_{ij,t-1}$) in matrix $G$ indicate that volatility spillovers existed between all four markets of the region. In addition, the number of significant coefficients is higher (22) in the second sub-period in comparison to the first sub-period (8) in terms of volatility spillovers. This result indicates that there is more evidence of transmission of volatility among the region's markets over the more recent period, which may be due to the introduction of various financial and trade liberalisation policies within the region (see Chapter 2 for more details). These findings indicate that by implementing these policies, the stock markets in the South Asian region have become more inter-dependent in terms of news from their regional markets. This fact is confirmed by the findings of significant spillovers from the region's largest (Indian) stock market to the three relatively smaller markets of South Asia. In addition, according to the International Financial Statistics Yearbook, foreign trade among the South Asian countries increased during recent years, which may have resulted in more integration among the markets over the more recent years[192]. As a result of these developments in the regional markets, one would expect more transmission mechanisms in terms of both return and risk. These results are also in agreement with the findings in Chapter 5 which showed more integration among the markets in the second sub-period.

**7.6: Conclusion**

This chapter has investigated return and volatility spillover effects between the four emerging stock markets of Bangladesh, India, Pakistan and Sri Lanka. From the multivariate GARCH-BEKK findings for the weekly stock market indices, evidence of linkages in terms of both return and volatility was found. In particular, the results from the analysis indicated bidirectional return spillovers between Bangladesh and India, Bangladesh and Sri Lanka and between Pakistan and India, as well as a unidirectional return linkage between Pakistan and Sri Lanka.

Evidence of a spillover from shocks was found between Bangladesh and Pakistan and between India and Sri Lanka at the five per cent level of significance. In terms of cross – shock spillover effects in the markets, past innovations in the Indian and Pakistani markets had an effect on the two smaller markets of Bangladesh and Sri Lanka. The results also revealed unidirectional shock spillover effects from the Bangladeshi and Pakistani markets to the Sri Lankan market whereas the shock spillover was bidirectional between India and Sri

[192] The reader is referred to Table 2.4 for more details about recent trade among the four South Asian countries.

Lanka. In terms of volatility spillovers, evidence was found between India and Sri Lanka. Evidence of a unidirectional volatility spillover was found from India to Pakistan. Overall, volatility persistence was high for India and low for Sri Lanka where the coefficient values are 0.92 and 0.27, respectively. These volatility spillovers were both direct (from another market) as well as indirect (spillover from the covariance of two markets). In general, the results indicate significant interactions among the four South Asian stock markets equity indices. There was a significant transmission of return and volatility among all of these stock markets.

The findings of the chapter suggest that the interactions among the four markets being examined increased after 9/11; the markets were integrated in the post-September 2001 period only. In addition, there were more shocks and volatility spillovers in the second sub-period as compared to the first sub-period. In particular, the Pakistani stock market as one of the frontline States in the war-on-terror became a more influential market in terms of both return and volatility spillovers after 9/11; this may have been due to the inflow of funds from the US to Pakistan promoting the importance of the market in the region.

International portfolio diversification has grown in popularity over the last few decades, and foreign investors invest in various emerging stock markets around the globe. This chapter has uncovered evidence of transmission among South Asian stock markets and has shown that stock markets in this region interact with each other in terms of return and volatility. The findings have implications for potential foreign investors investing in the region in terms of benefits from diversification; 'news' impacting one stock market will eventually spread to other markets of the region though their interdependence. In particular, information transmits from the relatively larger markets of India and Pakistan and spreads to the smaller markets. In addition, share price changes can be predicted from historical share price movements in the region; hence the markets in the region violate the weak form of the EMH.

# Chapter 8

# Conclusion

## 8.1: Introduction

This thesis has examined a number of issues relating to market efficiency for four emerging stock markets in the South Asian region. The topic was chosen after an analysis of substantial literature revealed a gap in our knowledge about the efficiency of the markets and linkages between the equity prices of the stock exchange indices. In particular, the empirical research was carried out for the four emerging stock markets of Bangladesh, India, Pakistan and Sri Lanka. A mix of quantitative techniques was employed with weekly stock price data over an 18-year period from 1993 to 2010. To date, a majority of previous studies in this area have investigated other developed and emerging markets; the South Asian region has mostly been ignored. In addition, the small number of studies which have examined the South Asian markets are either fairly dated (for example, Narayan et al., 2004) or emphasise the countries in this region in relation to other developed markets (for example, Lamba, 2005). Prior studies have focused on one or two of the South Asian markets as part of a broader sample (for example, Elyasiani et al., 1998; Goldberg and Dalgado, 2001; Yang et al., 2003).

Moreover, previous studies which investigated the relationship between economic variables and share price changes in the region have only focused on domestic measures of economic performance and ignored global factors which have been found to be important in other studies of emerging markets (Harvey, 1995; Fifield et al., 2002; Fifield and Power, 2006). Therefore, the current thesis examines the relationships between both local and global economic factors with the share price changes in the region. In addition to examining the interactions among stock market indices and macroeconomic variables, the current thesis explores the interaction among markets from the perspective of volatility transmission. To the best of the researcher's knowledge, no previous study has examined return and volatility spillovers simultaneously using the multivariate GARCH-BEKK model. Such an analysis has implications for market efficiency as well as for international portfolio diversification in the region.

The empirical analysis in the thesis began by examining the long- and short-run linkages among the stock market indices of the four South Asian countries being studied. This analysis was conducted by using multivariate cointegration analysis, Granger Causality tests, VECM, IRF analysis and variance decomposition analysis. Following this initial analysis, the assumption that local and global economic variables explain changes in share prices was examined. This examination considered whether local factors affect share prices in the region or whether local and global factors taken together are important in explaining variations in share prices. Once the relationships among the different markets had been investigated, the thesis proceeded to examine the transmission mechanism by which news was dissipated from the perspective of volatility spillovers. This analysis is important since it examines the interactions among the markets in greater depth; as a result, the findings have implications for investment decisions in the region. Finally, the thesis has examined inter-relationships among the markets for the entire sample period 1993- 2010 as well as for two sub-periods: pre- and post- September 2001. Previous studies, (e.g. Bekaert and Harvey, 1995; Masih and Masih, 2004) have argued that integration among stock markets has increased over time as well as after the occurrence of important international events. The findings from the GARCH-BEKK model which investigated interactions among the markets from a volatility and mean return spillover perspective compliment the results from the cointegration analysis conducted at the start of the thesis which suggested that returns in the four markets being studied were linked to one another – especially in the second sub-period.

The remainder of this chapter is organised as follows. Section 8.2 summarises the empirical findings of the thesis and highlights the major conclusions that can be drawn. The limitations of the research are discussed in Section 8.3, while Section 8.4 highlights potential avenues for future research in the stock markets of the South Asian region. Section 8.5 concludes the chapter.

## 8.2: Main Findings

The thesis analyses market efficiency in four emerging stock markets from the South Asian region over the 1993 to 2010 time period. This section summarises the findings about this issue and discusses the implications of the research for interested stakeholders and policymakers. A number of conclusions emerge from this summary. First, the results indicate that there is a relationship between the equity price changes of the four markets being studied. The analysis of Chapter 5 highlighted that these markets co-move together in the long-run. A single cointegrating vector was found in the entire sample period as well as in the post-September 2001 sub-period. These findings indicate that the four markets behave in an equilibrium fashion over the long-run, even if they deviate from this equilibrium in the short-run. Results from techniques which quantify relationships in the short-run support these findings although they suggest that linkages in the short-run are relatively weaker. For example, at a 20-week horizon, the proportion of any particular stock markets' variance that is collectively explained by other South Asian stock market indices ranges from 0.70 per cent (for Bangladesh and India) to almost 5.00 per cent (for Pakistan and Sri Lanka). The findings from this analysis suggest that the potential for diversifying risk by investing in the South Asian region is limited - especially in the long-run. Although, short-run benefits may be available, the comovement between the markets in the long-run suggests that the gains from diversification may not be sizeable. In addition, the findings suggest that the markets are not weak form efficient since share price changes in the region's markets are predictable from historical price data; this finding is evident from the VECM analysis which suggests that returns in the short-run can be predicted by past price changes as the markets revert back to their long-run equilibrium relationships. Hence, the weak form of the EMH may not be tenable.

Second, one reason why the equity returns from markets in the region may be linked is that the stock exchanges in the South Asian region have started to co-operate more closely with one another. Membership of bodies such as SAARC, SAFE and SAFTA may have promoted co-operation among these exchanges and resulted in greater links between the different nation's equity returns. In addition, the finding of increased integration among these markets may be part of a more general trend internationally. For example, previous studies which have investigated financial market linkages have argued that emerging markets are becoming increasingly integrated into the global financial system (Bekaert, 1995; Bekaert and Harvey, 1995). The investigation in the current thesis supports this notion and finds that linkages among the markets of Bangladesh, India, Pakistan and Sri Lanka have increased over time[193]. The findings therefore support results from some recent studies which have documented that integration among the markets has increased as a consequence of important international events such as the global stock market crash of 1987 and the 1997 Asian crisis (Masih and Masih, 1999, 2002). In this thesis, more integration was found among the markets in the post-September 2001 period which supports the assumption put forward by some previous studies that a major exogenous shock will increase integration among markets by causing prices to move by a significant amount in the same direction. As the benefits from diversification depend on the degree of market segmentation, any increase in the integration of these emerging markets into the global financial system may result in a lessening of the benefits from investment in Bangladesh, India, Pakistan and Sri Lanka equities. It is clear from the

[193] For example, the evidence of cointegration was stronger in the second sub-period relative to the first. In addition, GARCH models suggested that volatility spillovers were more pronounced after 2001 than before.

findings that South Asian markets have become more integrated in the recent time period and that the benefits from diversifying into this region are limited in the long- run.

Another reason why linkages among the stock markets in these four countries may have strengthened is because the real economies of these nations may have become more integrated. The liberalisation policies introduced in the 1990s and the lessening of political tensions may have increased trade among the countries; the financial systems may have become more linked as a result. The results obtained from the analysis of inter-relationships between macroeconomic variables and share price changes in Chapter 6 would support this view; they indicate that contemporaneous changes in both local and global economic variables are important in explaining share returns in the region[194]. In the initial analysis, it was found that economic variables were highly correlated; hence, PCA was employed to reduce the dimensionality in the dataset and construct principal components[195]. Following the approach of Fifield et al. (2002) and Fifield and Power (2006), the PCs which were constructed from the variables were used as inputs into a regression analysis. Based on the three local PCs and two global PCs used as inputs in the regression model, the findings suggest that variation in the share prices of the region could be predicted from contemporaneous as well as historic changes in the macroeconomic factors[196]. These findings indicate that investors may be able to predict future security returns by estimating the trends in local economic factors for these markets. This finding that historical information can be used to predict share price changes in the South Asian stock markets lends further support to the notion that these stock markets are not weak form efficient.

[194] Historical domestic economic factors were more important than global factors in predicting share returns in the region.
[195] The correlations among the variables ranged from a low of 0.30 to a high of 0.90 per cent.
[196] The results are in agreement with the findings of previous studies, for example, Fifield et al. (2002) and Fifield and Power (2006).

Third, the thesis offers a number of insights into the nature of any integration among the four South Asian markets. The results reported in Chapter 7 are consistent with the findings documented in earlier chapters of this thesis. In particular, interactions among the four emerging stock markets of South Asia are due to volatility as well as return spillovers. These interactions are evident from the findings in Chapter 7. Additionally, the evidence supports the notion that ‘news’ in one market influences not only the return of that market but also the variance of price changes in other markets. These findings imply that equity returns in the South Asian stock markets are predictable from historical share price changes in their own, as well as from the other markets of the region; this result calls the weak form of the EMH into question since it suggests that an investor could outperform by studying historic return volatility - especially in the Indian market. In addition, the findings support the ‘global centre’ hypothesis which suggests that larger international financial centres play a major role in the transmission of information. In the current thesis, India and Pakistan, being the two relatively large markets in the region, seem to exert a sizeable influence on the relatively smaller markets of Bangladesh[197] and Sri Lanka. For example, the dominance of the Indian market is evident from the finding that in the long-run the Indian market is not led by the relatively smaller markets of the region. In addition, the Pakistani market has relatively more influence on the variations in the share prices in the two smaller markets of Bangladesh and Sri Lanka.

Finally, the thesis indicates that interactions among the South Asian markets have increased over time in terms of volatility transmission. In terms of volatility spillovers, there were 22 significant coefficients in the 2001 - 2010 time periods in comparison to only eight significant coefficients in the first sub-period. This finding supports the results in Chapter 5 which showed that integration among the markets has increased in the more recent time

[197] Although Bangladesh was isolated from the regional markets in the perhaps due to lower intra-regional trade, more recently it has become more integrated especially with the Pakistani market.

period studied. In addition, these findings support the evidence from the substantive literature which suggests that integration among stock markets has increased over time (Bekaert and Harvey, 1995).

### 8.3: Limitations of the Study

This research has attempted to address a number of issues relating to market efficiency and portfolio diversification in four emerging stock markets from the South Asian region. In particular, it has examined: (i) the integration among the markets in the long- and short-term by employing advanced econometric techniques; (ii) the inter-relationships among stock returns and macroeconomic variables from both a domestic and international perspective; (iii) the interactions among the stock markets in terms of return and volatility spillovers. Although the thesis has made every attempt to provide a comprehensive and detailed analysis of these issues, some limitations remain. These limitations are discussed in this section of the concluding chapter.

First, as with any academic study, there are limitations in this thesis relating to the sample analysed. The quantitative element of this thesis investigates share price data for four stock exchanges geographically located in the South Asian region; although these four stock exchanges are the largest and longest established in the region, other newly established markets such as Bhutan, Maldives and Nepal are ignored[198]. The short history of these newer markets made it difficult to carry out any methodologically consistent empirical analysis as data series would not have been long enough. Therefore, sample is restricted to the four

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[198] For example, although established in 1993, as at the end of 2008, only 21 companies were listed on the Royal Securities Exchange of Bhutan. In Maldives, the Capital Market Development Authority (CMDA) was established in 2006 which later resulted in the establishment of the Maldives Stock Exchange in 2008. In Nepal, the stock market was established in 1994; it remained undeveloped until 2007. As at the end of 2009, only 171 companies were listed on the Nepal Stock Exchange (South Asian Financial Market Review, 2010).

established markets of Bangladesh, India, Pakistan and Sri Lanka. Despite this limitation, the thesis represents an important step in modelling South Asian stock returns and provides a platform upon which further research can build as more data become available for the other markets in the region.

Second, although previous studies (for example, Click and Plummer, 2005) have argued that results for integration are consistent irrespective of whether local or foreign currencies are examined, the current thesis only investigates linkages among the returns of the four stock markets of the region in local currency. As indicated in Chapter 1, the research questions seek to determine whether share returns in the four South Asian markets are inter-related; in such a situation, data in local currency was thought to be preferable as investors were assumed to focus on equity rather than currency speculation. Typically, when analysing integration among the stock markets from the foreign investor's perspective, a common currency might be used for investigation. However, the common currency raises the possibility that some portion of inter-dependence across (local currency denominated) domestic markets would not be captured if exchange rates offset economic shocks that, in reality, link the domestic markets together (Click and Plummer, 2005). Thus, a choice was made to analyse relationships between equity returns denominated in local currency, although the researcher recognises that a different decision could have been made. Again, this might be an issue which subsequent investigations might examine[199].

Third, transaction costs such as fees, commissions and taxes which are paid by investors were not taken into account in the current thesis. Without taking transaction costs into account the profits available for investors might be overstated relative to any actual profits that might be

[199] In addition, the current thesis used index data for the four markets of Bangladesh, India, Pakistan and Sri Lanka and ignored individual company or sectoral securities data. Although in the current investigation the results are comparable to many previous studies which have used index data, for future work, company level data or sectoral data may be used to investigate linkages within these markets as well as with similar sectors in other countries of the region.

gained. Therefore, the current findings may be biased against the EMH in this thesis. A detailed analysis of the costs associated with security transactions in the four countries was thought to be an important issue in its own right. In addition, this thesis has not examined any changes in transaction costs over the period being studied. However, evidence from Standard and Poor's (2011) suggests that the expenses associated with the purchase and sale of securities in emerging markets have declined over the past decade. Further, summary information from Standard and Poor's (2011) indicates that transaction costs within the four countries are comparable and thus suggests that any differential impact of such expenses might be minimal. However, a follow-up study which takes the findings from the ECM, regression analysis and spillover analysis and attempts to implement a trading strategy in order to examine whether any gains from trading on the basis of past information might be achievable could factor transaction costs into its calculations.

Finally, all of the econometric techniques used in this thesis are subject to a number of limitations. For example, the PCA method used for extracting PCs from the macroeconomic variables has been criticised for a number of reasons. According to Dunteman (1994), when several variables in the principal component vectors have large coefficients of either sign, it can often be difficult to interpret the principal components. In the current thesis this limitation was not a big concern as, in each of the four markets, the identity of the high loading variables in each PC vector was relatively unambiguous. In addition, although criteria for deciding on how many PCs to extract for further analysis are provided in the literature, the final choice on the number of PCs used is subjective (Dunteman, 1994). Finally, although the PCs explain most of the variation in the original variables, they may not be the most useful as explanations for dependent variables (Brooks, 2008). Therefore, in the current thesis, although the PCs explain most of the variation in the original local and international economic factors, they may not be the most useful explanatory factors for South Asian emerging stock market share returns.

### 8.4: Suggestions for Future Research

Some suggestions for future research emerge from the empirical analysis presented in this thesis. First, future work might re-examine the issues addressed in this thesis using a relatively more comprehensive data set (i) including more recent share price data; and (ii) data about the newly established stock markets located in the South Asian region such as Nepal and the Maldives. This research would be particularly valuable as a more recent time period might incorporate more member countries of SAARC and might indicate how integration among the regional stock markets is continuing to change over time.

Second, future investigations which focus on market efficiency using trading strategies which draw on the ECM and spillover results for the region would be valuable. The analysis contained in this thesis suggests that share price changes can be predicted from historical data; any such predictability could be further analysed to see whether practical arbitrage opportunities are available from investing in the region. The current thesis suggests that while predictability may exist, in contradiction of the weak form of the EMH, any relationships between current prices (or price changes) and historic information is complex. The results indicate that in addition to past information in its own market, lagged details from the three other markets in the region may be important in forecasting future prices (price changes). In addition, the findings indicate that not only does historic return information have a possible role to play in predicting future price changes, past volatility appears to be a key variable in the transmission of news from the past to the present.

Third, the current thesis focuses exclusively on the South Asian region with very little attempt to analyse the relationships of the Bangladeshi, Indian, Pakistani and Sri Lankan markets with the developed markets of the UK and US. Although the current analysis may be of interest to investors in developed countries, a more specific investigation of the links between the markets of this region with the UK and US might be needed before foreign investors commit to purchasing Bangladeshi, Indian, Pakistani and Sri Lankan shares. Examining how the developed markets of the UK and the US affect the emerging markets of the region could be valuable.

Fourth, future research could examine why various domestic and global factors are important in various countries of the region. Possible reasons may include differences in tax systems, improvements in market structures and differences in the financial liberalisation processes which have taken place. In addition, future research could examine the informational content of other macroeconomic variables in explaining equity returns; as previous studies have indicated other variables including fundamental factors such as size, turnover, dividend yield and PE ratio could be used to explain share return (Fifield and Power, 2006). Thus, future research including both economic and fundamental factors may be fruitful.

Fifth, an analysis of cross-country integration with respect to economic information is an area for future research. It is not studied in the current thesis. Thus, future research could see whether any integration among the markets is due to the linkages among economic fundamentals in the different markets. In addition, future research might investigate whether domestic or global economic factors were important in explaining share returns in the regional markets by analysing how stock returns in a country are affected by economic performance of the country as well as other countries in the same region and international economic factors which are hypothesised to affect returns.

Finally, using data of higher frequency (intra-day) can provide out-of-sample forecasting experiments and supply additional insights into the robustness of the findings in the current investigation. Such an exercise was not pursued in the current thesis as Andersen and Bollerslev (1998) argued that using the squared residuals in daily or lower frequency data may give an inaccurate assessment of the forecasting ability of volatility models even when the model is correctly specified. In the current thesis, weekly data are used for methodological consistency and comparability among various empirical chapters in the thesis. The use and availability of intra-daily data would be useful for any such analysis in the future.

### 8.5: Conclusion

No piece of academic research is fully complete and perfect and the current research is not an exception. In fact, due to technological, communication and regional and international financial developments, the countries in the developing world change very frequently. In such changing environments, the behaviour of stock markets also changes over time and hence, research in these countries is never ‘complete’. Nevertheless, the current thesis does demonstrate the learning process of the researcher and contributes to knowledge about this important topic. As a result, it should represent a starting point for further work on the topic of market efficiency and international portfolio diversification in emerging stock markets in general and in the South Asian region in particular.

# Appendices

## Appendix 5.1:

### Plots of the Cointegrating Vectors for the Entire Period and for the Two Sub-Periods

**Figure 5.1 Entire Period**

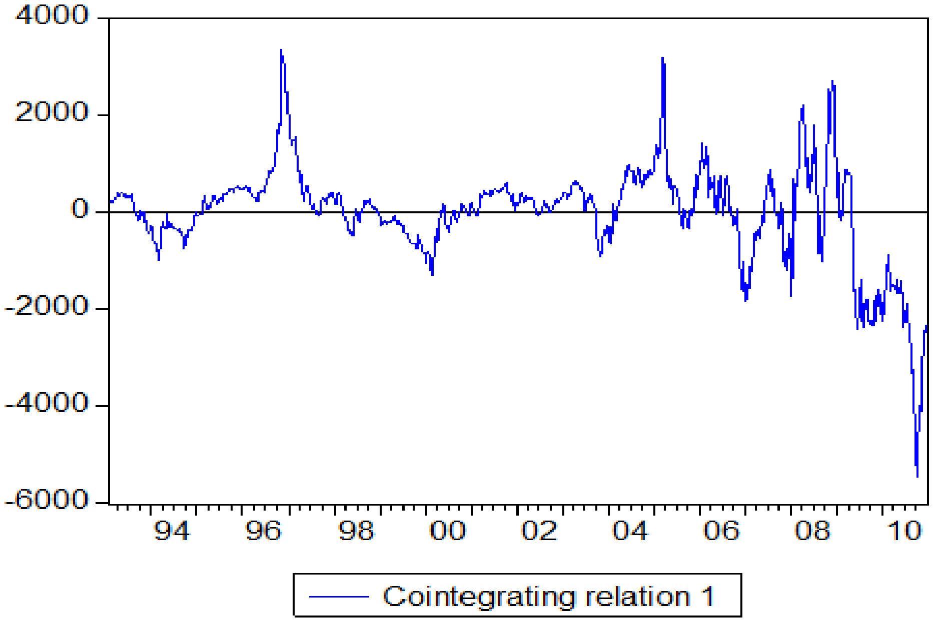



**Figure5.2 Sub-Period 1**

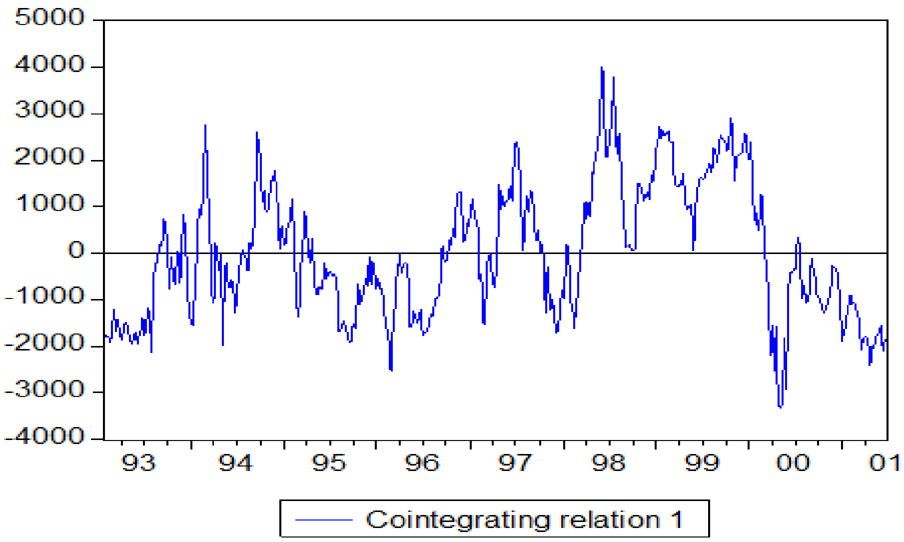
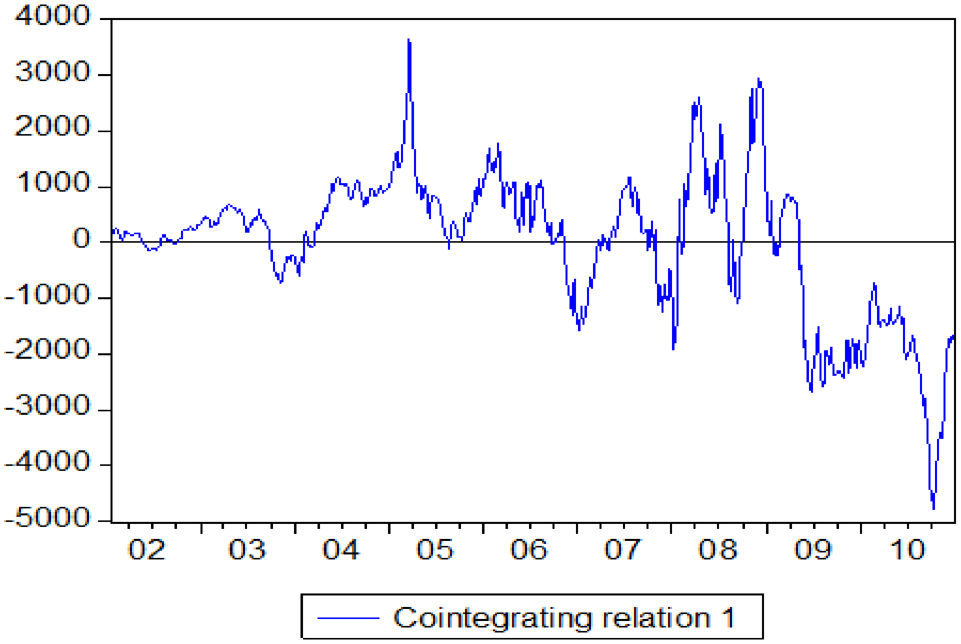
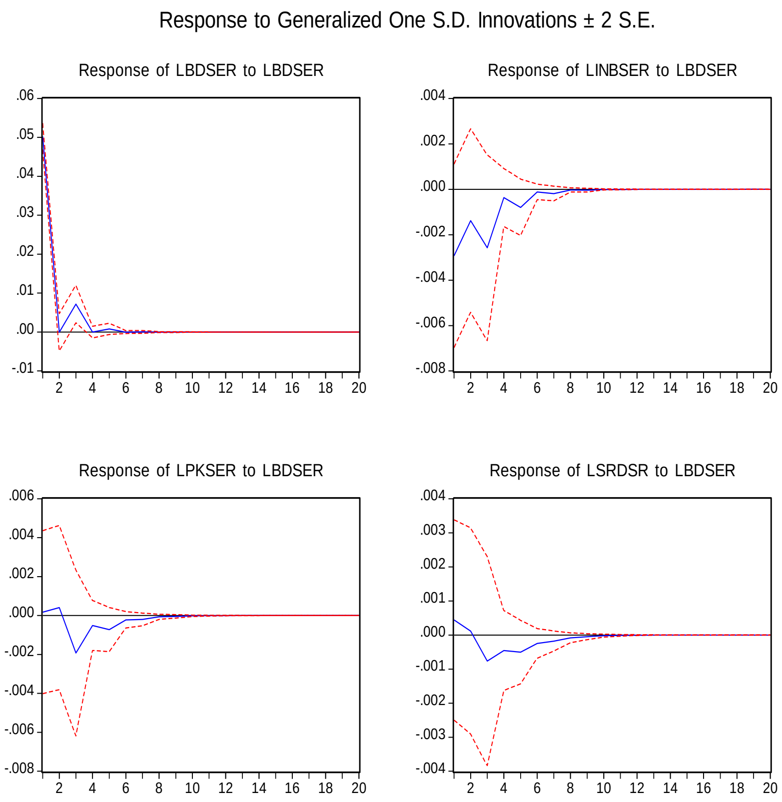


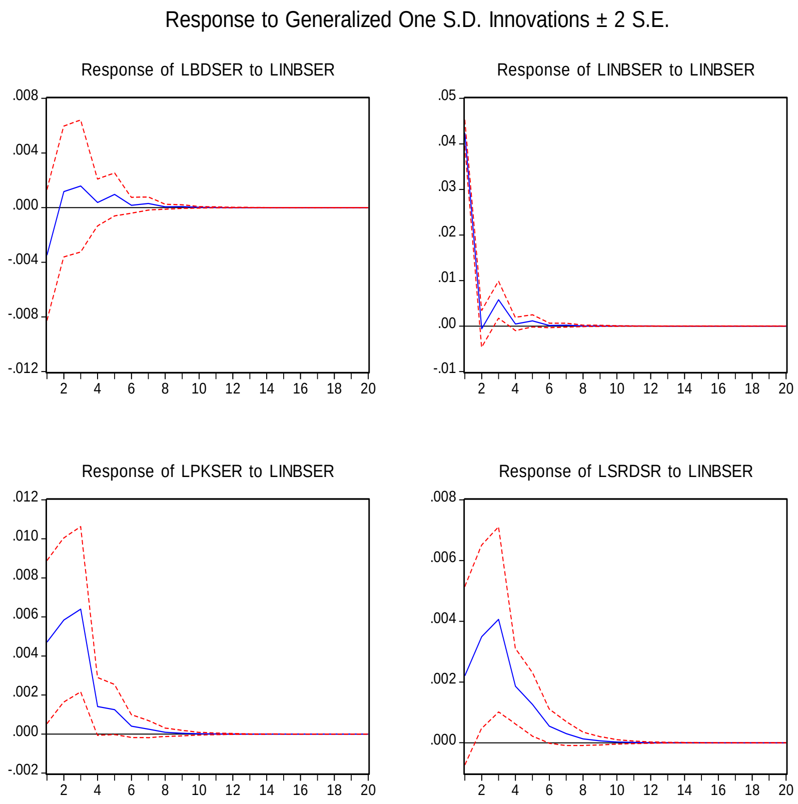
**Figure 5.3 Sub-Period 2**



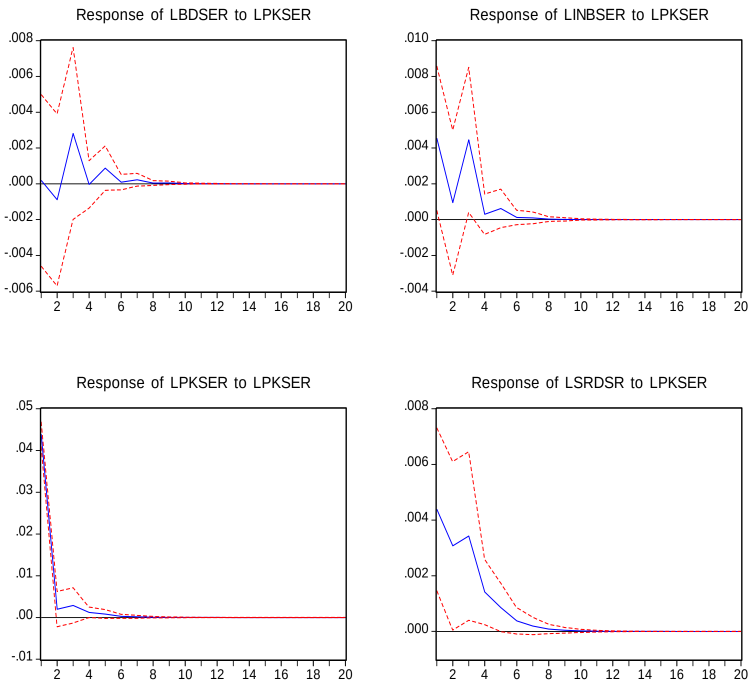
# Appendix 5.2

## Figures for Generalised Impulse Response Functions for Sub-Period 1

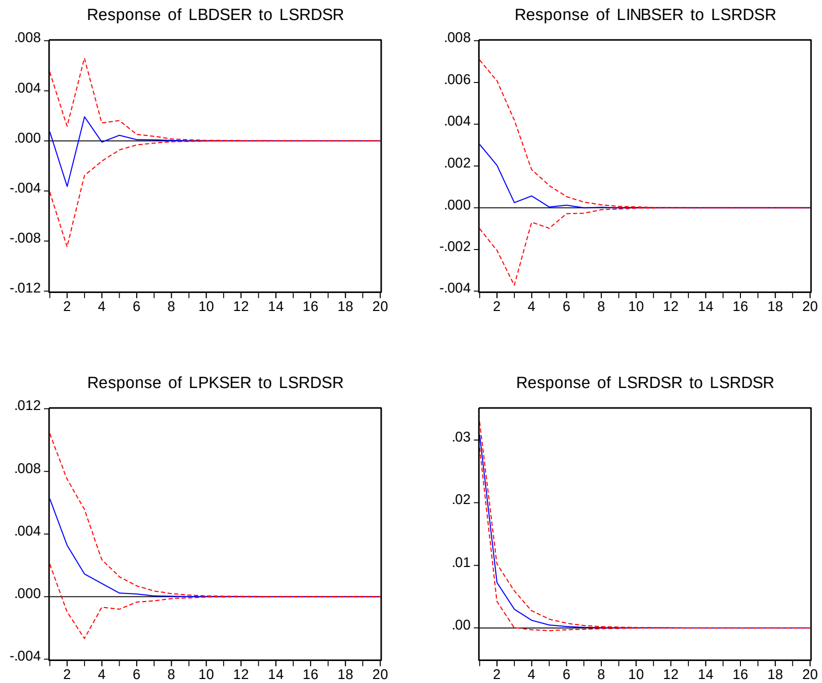


Response to Generalized One S.D. Innovations ± 2 S.E.

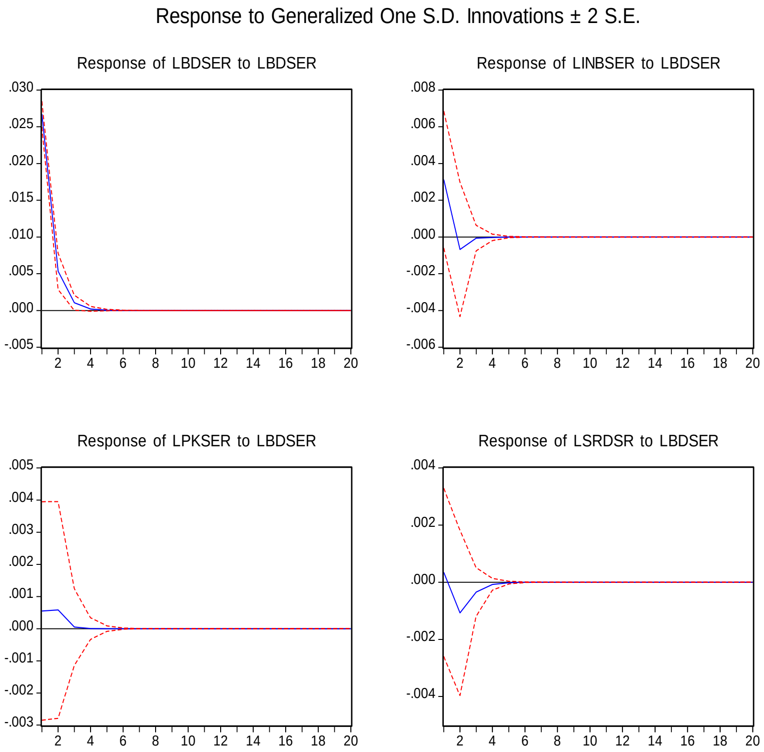


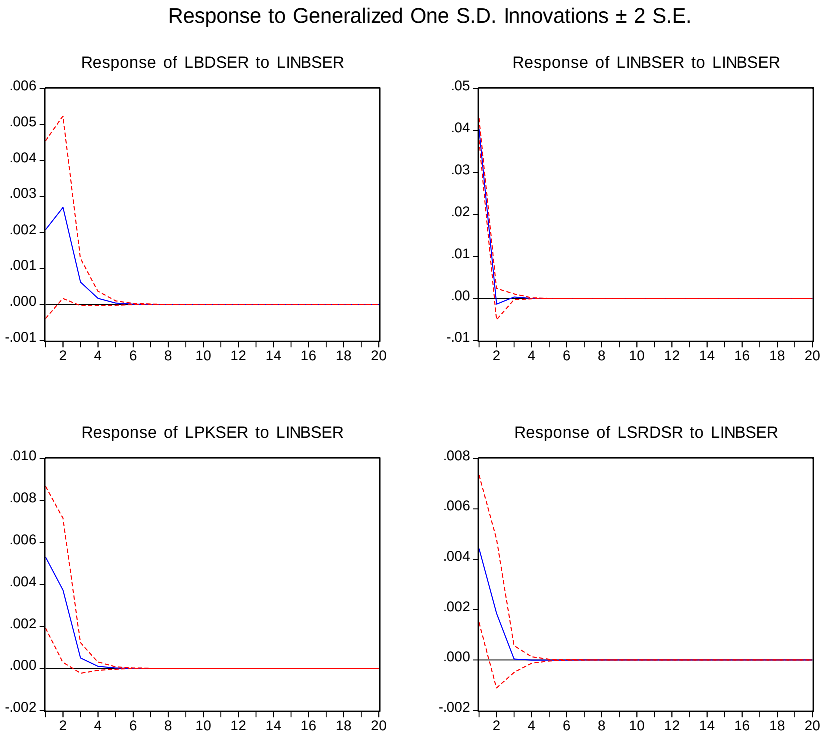

Response to Generalized One S.D. Innovations ± 2 S.E.



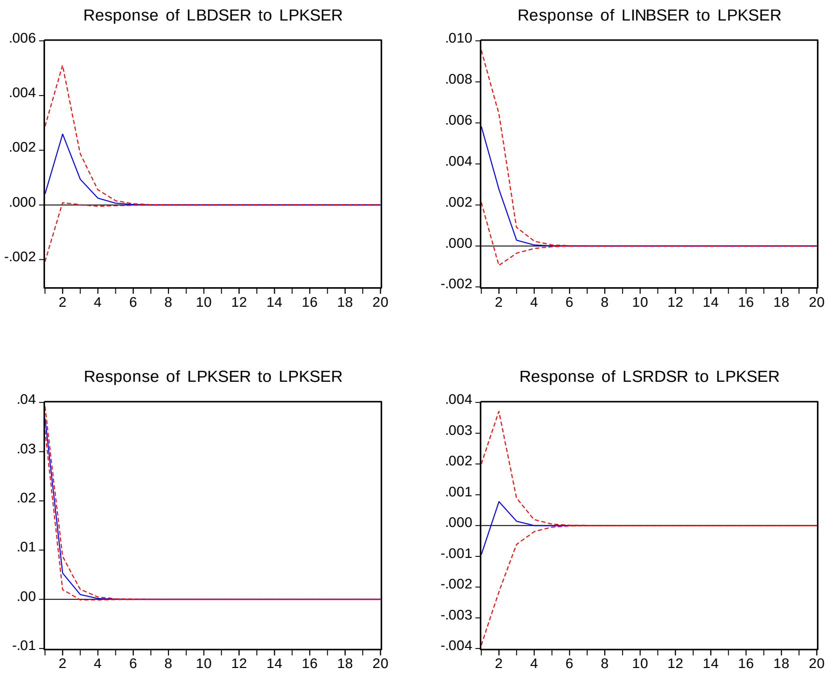
## Appendix 5.3:

## Figures for Generalised Impulse Response Functions for Sub-Period 2

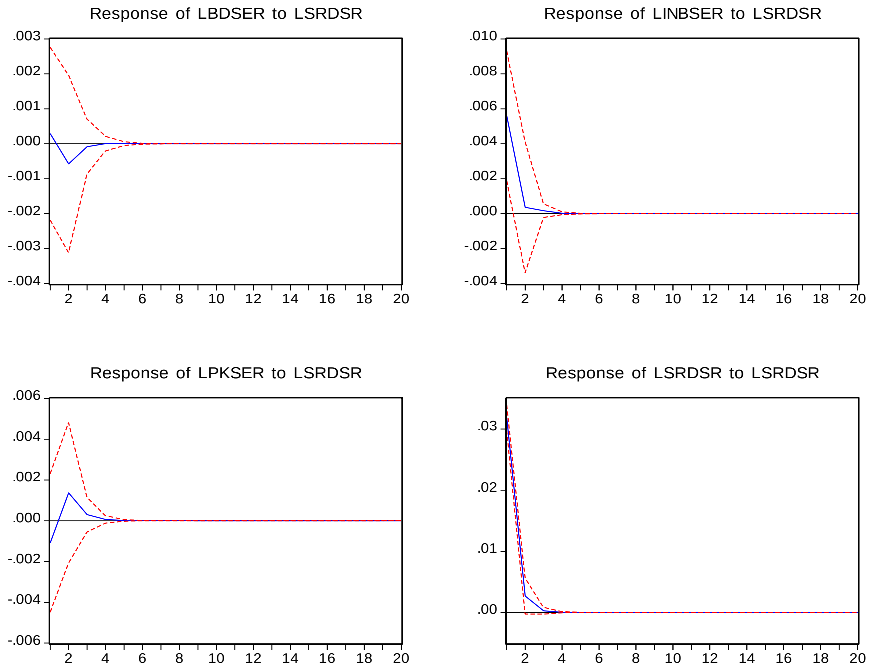


Response to Generalized One S.D. Innovations ± 2 S.E.




Response to Generalized One S.D. Innovations ± 2 S.E.



**Appendix 6.1: Regression analysis of the monthly shares returns for the Four South Asian Emerging Markets.**

| Country | LPC1 | LPC2 | LPC3 | GPC1 | GPC2 | $R^2L\%$ | $R^2L\&G\%$ |
|---|---|---|---|---|---|---|---|
| **Bangladesh** | 0.012* | 0.015* | -0.007 | ------ | ------ | 6.7 | ------ |
| | (0.027) | (0.009) | (0.148) | | | | |
| | 0.013* | 0.013* | -0.008 | 0.002 | 0.007 | ------ | 6.4 |
| | (0.029) | (0.027) | (0.095) | (0.497) | (0.112) | | |
| **India** | -0.005 | -0.004 | -0.039 | ------ | ------ | 17.1 | ------ |
| | (0.217) | (0.430) | (0.000) | | | | |
| | -0.005 | -0.005 | -0.029* | 0.013* | 0.019* | ------ | 23.5 |
| | (0.190) | (0.252) | (0.000) | (0.028) | (0.002) | | |
| **Pakistan** | 0.004 | -0.015* | 0.004 | ------ | ------ | 3.4 | ------ |
| | (0.379) | (0.040) | (0.575) | | | | |
| | 0.004 | -0.015* | 0.004 | 0.009 | 0.014 | ------ | 6.8 |
| | (0.379) | (0.050) | (0.530) | (0.166) | (0.130) | | |
| **Sri Lanka** | -0.001 | -0.014* | 0.013* | ------ | ------ | 5.4 | ------ |
| | (0.794) | (0.015) | (0.050) | | | | |
| | -0.005 | -0.013* | 0.015* | 0.001 | 0.017* | ------ | 10.1 |
| | (0.230) | (0.032) | (0.015) | (0.868) | (0.001) | | |

The table reports the results from regressing the lagged local and global principal components on the monthly returns of the four South Asian markets over the 13-year period 1998-2010. In particular, the table reports the coefficient values for the respective local and global principal components, the p-values and the adjusted $R^2$ values for the local regression ($R^2L$) and for the global and local regression ($R^2L\&G$). An * indicates that the coefficient values for the principal components are significant at the five per cent level.

**Appendix 6.2: Correlation Between Share Prices and Macroeconomic Variables: Bangladesh**

| Local Variables | BDSE | CPI | EXP | EXR | IMP | IP | MS | TBR |
|---|---|---|---|---|---|---|---|---|
| BDSE | 1.000 | | | | | | | |
| CPI | 0.949 | 1.000 | | | | | | |
| EXP | 0.907 | 0.966 | 1.000 | | | | | |
| EXR | 0.832 | 0.917 | 0.945 | 1.000 | | | | |
| IMP | 0.923 | 0.970 | 0.966 | 0.924 | 1.000 | | | |
| IP | 0.900 | 0.968 | 0.968 | 0.940 | 0.952 | 1.000 | | |
| MS | 0.953 | 0.993 | 0.966 | 0.929 | 0.968 | 0.969 | 1.000 | |
| TBR | -0.435 | -0.348 | -0.247 | -0.131 | -0.245 | -0.270 | -0.347 | 1.000 |
| **World** | | | | | | | | |
| MSCI | 0.170 | 0.237 | 0.285 | 0.233 | 0.290 | 0.231 | 0.219 | 0.060 |
| WCPI | 0.925 | 0.982 | 0.970 | 0.963 | 0.965 | 0.971 | 0.985 | -0.285 |
| WGDP | 0.919 | 0.980 | 0.957 | 0.899 | 0.958 | 0.959 | 0.973 | -0.302 |
| OIL PR | 0.837 | 0.903 | 0.930 | 0.926 | 0.914 | 0.910 | 0.903 | -0.158 |
| USTBR | -0.701 | -0.679 | -0.572 | -0.512 | -0.595 | -0.622 | -0.682 | 0.568 |

BDSE, CPI, EXP, EXR, IMP, IP, MS and TBR denote the log values of Bangladeshi share price index, the consumer price index, exports, exchange rates, imports, the industrial production index, the money supply and the Treasury bill rate whereas MSCI, WCPI, WGDP, OIL PR and USTBR denote the world market return, the world consumer price index, world GDP, oil prices and the US treasury bill rate.

**Appendix 6.3: Correlation Between Share Prices and Macroeconomic Variables: Indian**

| Local Variables | INBSE | CPI | EXP | EXR | IMP | IP | MS | TBR |
|---|---|---|---|---|---|---|---|---|
| INBSE | 1.000 | | | | | | | |
| CPI | 0.367 | 1.000 | | | | | | |
| EXP | 0.930 | 0.396 | 1.000 | | | | | |
| EXR | -0.152 | -0.094 | 0.108 | 1.000 | | | | |
| IMP | 0.943 | 0.416 | 0.987 | 0.059 | 1.000 | | | |
| IP | 0.940 | 0.426 | 0.983 | 0.077 | 0.976 | 1.000 | | |
| MS | 0.933 | 0.409 | 0.988 | 0.129 | 0.985 | 0.987 | 1.000 | |
| TBR | -0.334 | -0.147 | -0.477 | -0.431 | -0.456 | -0.475 | -0.509 | 1.000 |
| **World** | | | | | | | | |
| MSCI | 0.501 | 0.003 | 0.246 | -0.617 | 0.278 | 0.254 | 0.217 | 0.448 |
| CPI | 0.907 | 0.355 | 0.986 | 0.188 | 0.977 | 0.975 | 0.993 | -0.534 |
| GDP | 0.932 | 0.498 | 0.966 | 0.049 | 0.974 | 0.972 | 0.976 | -0.454 |
| OIL PR | 0.921 | 0.226 | 0.935 | -0.010 | 0.939 | 0.903 | 0.916 | -0.327 |
| USTBR | -0.458 | -0.416 | -0.613 | -0.473 | -0.610 | -0.636 | 0.662 | 0.659 |

INBSE, CPI, EXP, EXR, IMP, IP, MS and TBR denote the log values of Indian share price index, the consumer price index, exports, exchange rates, imports, the industrial production index, the money supply and the Treasury bill rate whereas MSCI, WCPI, WGDP, OIL PR and USTBR denote the world market return, the world consumer price index, world GDP, oil prices and the US treasury bill rate.

**Appendix 6.4: Correlation Between Share Prices and Macroeconomic Variables: Pakistan**

| Local Variables | PKSE | CPI | EXP | EXR | IMP | IP | MS | TBR |
|---|---|---|---|---|---|---|---|---|
| PKSE | 1.000 | | | | | | | |
| CPI | 0.257 | 1.000 | | | | | | |
| EXP | 0.891 | 0.414 | 1.000 | | | | | |
| EXR | 0.620 | 0.459 | 0.872 | 1.000 | | | | |
| IMP | 0.923 | 0.438 | 0.974 | 0.823 | 1.000 | | | |
| IP | 0.888 | 0.252 | 0.830 | 0.624 | 0.867 | 1.000 | | |
| MS | 0.947 | 0.409 | 0.967 | 0.813 | 0.982 | 0.886 | 1.000 | |
| TBR | -0.024 | 0.700 | 0.127 | 0.219 | 0.190 | 0.084 | 0.141 | 1.000 |
| **World** | | | | | | | | |
| MSCI | 0.367 | 0.187 | 0.191 | -0.052 | 0.305 | 0.299 | 0.262 | 0.336 |
| CPI | 0.910 | 0.357 | 0.977 | 0.880 | 0.973 | 0.855 | 0.982 | 0.080 |
| GDP | 0.882 | 0.550 | 0.944 | 0.841 | 0.969 | 0.850 | 0.973 | 0.286 |
| OIL PR | 0.929 | 0.318 | 0.914 | 0.722 | 0.941 | 0.826 | 0.926 | 0.123 |
| USTBR | -0.408 | -0.428 | -0.664 | -0.830 | -0.582 | -0.419 | -0.596 | -0.017 |

PKSE, CPI, EXP, EXR, IMP, IP, MS and TBR denote the log values of Pakistani share price index, the consumer price index, exports, exchange rates, imports, the industrial production index, the money supply and the Treasury bill rate whereas MSCI, WCPI, WGDP, OIL PR and USTBR denote the world market return, the world consumer price index, world GDP, oil prices and the US treasury bill rate.

**Appendix 6.5: Correlation Between Share Prices and Macroeconomic Variables: Sri Lanka**

| Local Variables | SLSE | CPI | EXP | EXR | IMP | IP | MS | TBR |
|---|---|---|---|---|---|---|---|---|
| SLSE | 1.000 | | | | | | | |
| CPI | 0.887 | 1.000 | | | | | | |
| EXP | 0.845 | 0.908 | 1.000 | | | | | |
| EXR | 0.793 | 0.899 | 0.863 | 1.000 | | | | |
| IMP | 0.883 | 0.949 | 0.930 | 0.872 | 1.000 | | | |
| IP | 0.855 | 0.945 | 0.891 | 0.827 | 0.924 | 1.000 | | |
| MS | 0.941 | 0.978 | 0.917 | 0.889 | 0.956 | 0.951 | 1.000 | |
| TBR | -0.337 | -0.044 | -0.042 | -0.087 | -0.042 | -0.050 | -0.148 | 1.000 |
| **World** | | | | | | | | |
| MSCI | 0.257 | 0.179 | 0.281 | 0.054 | 0.329 | 0.299 | 0.265 | 0.306 |
| CPI | 0.888 | 0.991 | 0.919 | 0.933 | 0.953 | 0.942 | 0.982 | -0.085 |
| GDP | 0.857 | 0.977 | 0.869 | 0.819 | 0.916 | 0.939 | 0.960 | 0.008 |
| OIL PR | 0.844 | 0.909 | 0.908 | 0.844 | 0.956 | 0.891 | 0.924 | 0.011 |
| USTBR | -0.516 | -0.684 | -0.509 | -0.587 | -0.536 | -0.607 | -0.602 | 0.278 |

SLSE, CPI, EXP, EXR, IMP, IP, MS and TBR denote the log values of Sri Lankan share price index, the consumer price index, exports, exchange rates, imports, the industrial production index, the money supply and the Treasury bill rate whereas MSCI, WCPI, WGDP, OIL PR and USTBR denote the world market return, the world consumer price index, world GDP, oil prices and the US treasury bill rate.

**Appendix 6.6: Eigenvalues and Proportion of Variance Explained by the Principal Components: Local and Global Economic Variables (Logged level Series)**

| Country | | Principal Components | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| **BNG** | Eigenvalue | **5.868** | 0.948 | 0.079 | 0.042 | 0.034 | 0.023 | 0.006 |
| | Proportion | 0.838 | 0.136 | 0.011 | 0.006 | 0.005 | 0.003 | 0.001 |
| **IND** | Eigenvalue | **4.460** | **1.303** | 0.733 | 0.462 | 0.024 | 0.011 | 0.008 |
| | Proportion | 0.637 | 0.186 | 0.105 | 0.066 | 0.003 | 0.002 | 0.001 |
| **PAK** | Eigenvalue | **4.747** | **1.488** | 0.383 | 0.245 | 0.098 | 0.022 | 0.014 |
| | Proportion | 0.678 | 0.213 | 0.055 | 0.035 | 0.014 | 0.003 | 0.002 |
| **SRLK** | Eigenvalue | **5.575** | **1.003** | 0.186 | 0.119 | 0.062 | 0.041 | 0.015 |
| | Proportion | 0.796 | 0.143 | 0.027 | 0.017 | 0.009 | 0.006 | 0.002 |
| **World** | Eigenvalue | **3.318** | **1.414** | 0.182 | 0.066 | 0.019 | 0.000 | 0.000 |
| | Proportion | 0.664 | 0.283 | 0.037 | 0.013 | 0.004 | 0.000 | 0.000 |

The emboldened values indicate those PCs with eigenvalues greater than one, as well as those PCs which account for a large portion of the variation in the data. The cumulative proportion explained by the first two PCs is greater than 80 per cent for India and Pakistan. For the rest of markets, it is greater than 90 per cent.

**Entire Period Analysis by the Elements of the Matrix**

**Appendix 7.1: Estimated Coefficients for the Four Markets Multivariate GARCH Model**

| | **BDSE(*i* =1)** | **INBSE(*i* =2)** | **PKSE(*i* =3)** | **SRLK(*i* =4)** |
|---|---|---|---|---|
| α (*i*,1) | 0.8485* | 0.0109 | 0.1127* | -0.0008 |
| α (*i*,2) | -0.0729 | -0.2018* | 0.0323 | 0.1005* |
| α (*i*,3) | -0.1278* | -0.0440 | 0.4818* | 0.0007 |
| α (*i*,4) | -0.2006* | 0.1176* | -0.0647* | 0.2788* |
| g (*i*,1) | 0.8066* | 0.0048 | -0.0823 | 0.0047 |
| g (*i*,2) | 0.0057 | 0.9573* | -0.0720 | -0.4182* |
| g (*i*,3) | -0.0226 | 0.1470* | -0.6677* | -0.0040 |
| g (*i*,4) | 0.0211 | -0.0381* | 0.0022 | -0.5217* |
| Q (6) | 6.47 | 9.07 | 13.86 | 5.25 |
| Probability | (0.37) | (0.17) | (0.13) | (0.51) |
| Q (12) | 18.48 | 16.93 | 22.17 | 12.86 |
| Probability | (0.10) | (0.15) | (0.14) | (0.37) |
| $Q^2$ (6) | 2.23 | 8.97 | 13.82 | 9.96 |
| Probability | (0.89) | (0.17) | (0.13) | (0.13) |
| $Q^2$ (12) | 3.41 | 10.83 | 20.94 | 12.86 |
| Probability | (0.99) | (0.54) | (0.15) | (0.37) |

Q and $Q^2$ indicate Ljung–Box Q statistic values for the standardised and squared standardised residuals, respectively. Figures in parenthesis indicate probability values. Coefficients α and g captures ARCH and GARCH effects in the multivariate GARCH-BEKK model. An * indicates significance at the five per cent level.

**Sub-Period Analysis**

**Appendix 7.2: Estimated Multivariate GARCH Model Coefficients for the Four Markets:Pre- September, 2001**

| | **BNG** (*i*=1) | **IND** (*i* =2) | **PAK** (*i* =3) | **SRLK** (*i* =4) |
|---|---|---|---|---|
| μ | 0.0790 | 0.1867 | -0.0103 | -0.0129 |
| γ (*i*,1) | 0.0796 | -0.0446 | -0.0386 | -0.0045 |
| γ (*i*,2) | -0.0147 | 0.0118 | 0.1162* | 0.0317 |
| γ (*i*,3) | -0.0322 | 0.0261 | 0.0718 | 0.0706* |
| γ (*i*,4) | -0.0378 | 0.0738 | 0.1574* | 0.2487* |
| α (*i*,1) | 0.9173* | 0.1101* | 0.0814* | -0.0101 |
| α (*i*,2) | -0.1091 | -0.3362* | -0.2051* | 0.1455 |
| α (*i*,3) | -0.0820 | 0.0376 | 0.2761* | -0.0959 |
| α (*i*,4) | -0.0734 | 0.0422 | -0.1908* | 0.2783* |
| g (*i*,1) | 0.6879* | 0.1384* | -0.0792 | -0.1560 |
| g (*i*,2) | -0.0127 | 0.1925 | -0.0985 | -0.4995* |
| g (*i*,3) | -0.0703 | 0.2303 | -0.9270* | -0.1177 |
| g (*i*,4) | 0.0177 | -0.2771* | -0.1708 | 0.3699* |
| Q (6) | 11.96 | 14.53 | 4.21 | 2.74 |
| Probability | (0.06) | (0.12) | (0.65) | (0.84) |
| Q (12) | 19.65 | 16.10 | 9.93 | 5.85 |
| Probability | (0.07) | (0.19) | (0.62) | (0.92) |
| $Q^2$ (6) | 2.41 | 10.86 | 13.73 | 1.84 |
| Probability | (0.88) | ( 0.09) | (0.12) | (0.93) |
| $Q^2$ (12) | 6.41 | 15.71 | 24.74 | 25.44 |
| Probability | (0.89) | (0.18) | (0.02) | (0.01) |

Q and $Q^2$ indicate Ljung–Box Q statistics values for the standardised and squared standardised residuals, respectively. Figures in parenthesis indicate probability values. Coefficients α and g captures ARCH and GARCH effects in the multivariate GARCH-BEKK model. An * indicates significance at the five per cent level.

**Appendix 7.3: Estimated Multivariate GARCH Model Coefficients for the Four Markets: Post- September 2001**

| | BNG (*i=1*) | IND (*i=2*) | PAK (*i=3*) | SRLK (*i=4*) |
|---|---|---|---|---|
| μ | 0.4418* | 0.5320* | 0.8445* | 0.4065* |
| γ (*i*,1) | 0.2001* | -0.1328* | -0.0768 | -0.0658 |
| γ (*i*,2) | -0.0201 | -0.0109 | 0.0366 | 0.0408 |
| γ (*i*,3) | 0.0597 | 0.1069* | -0.0745 | 0.0543 |
| γ (*i*,4) | -0.0378 | 0.0143 | 0.0177 | 0.1534* |
| α (*i*,1) | 0.1443* | -0.0601 | 0.2453* | -0.0704* |
| α (*i*,2) | 0.1574 | 0.4164* | 0.0282 | 0.0491 |
| α (*i*,3) | -0.0544 | 0.1368* | -0.7011* | -0.0430 |
| α (*i*,4) | 0.0636 | 0.1054* | 0.0924* | 0.3237* |
| g (*i*,1) | 0.5717* | 0.3050* | -0.1838 | -0.0331 |
| g (*i*,2) | -0.7754* | 0.7741* | -0.3448* | -0.2058* |
| g (*i*,3) | 0.3342 | 0.0903 | -0.5746* | 0.0565 |
| g (*i*,4) | -0.2040* | -0.0078 | -0.0172 | 0.8644* |
| Q (6) | 14.47 | 4.10 | 4.24 | 8.20 |
| Probability | (0.12) | (0.66) | (0.15) | (0.22) |
| Q (12) | 22.99 | 17.54 | 16.28 | 14.37 |
| Probability | (0.03) | (0.13) | (0.12) | (0.27) |
| $Q^2$ (6) | 5.55 | 14.26 | 2.06 | 6.38 |
| Probability | (0.47) | (0.03) | (0.91) | (0.38) |
| $Q^2$ (12) | 14.25 | 18.63 | 4.57 | 10.73 |
| Probability | (0.20) | (0.10) | (0.97) | (0.55) |

Q and $Q^2$ indicate Ljung–Box Q statistics values for the standardised and squared standardised residuals, respectively. Figures in parenthesis indicate probability values. Coefficients α and g captures ARCH and GARCH effects in the multivariate GARCH-BEKK model. An * indicates significance at the five per cent level.

**Appendix 7.4: Engle (1982) ARCH Test**

| | | | |
|---|---|---|---|
| Bangladesh | F-Statistic | 8.204 | (0.000) |
| | $TR^2$ | 47.089 | (0.000) |
| India | F-Statistic | 12.792 | (0.000) |
| | $TR^2$ | 71.402 | (0.000) |
| Pakistan | F-Statistic | 21.847 | (0.000) |
| | $TR^2$ | 115.666 | (0.000) |
| Sri Lanka | F-Statistic | 8.699 | (0.000) |
| | $TR^2$ | 49.783 | (0.000) |

The test statistic for ARCH effects is calculated as $TR^2$, where T is the number of observations and $R^2$ is the coefficient of determination from the lagged squared errors regression. The test statistic is distributed as a $\chi^2$ distribution with six lags. The values in parentheses are *p*-values representing the probability that no ARCH effect is present in the data. In the above table, the null is rejected for all countries indicating the presence of ARCH effects.

**Appendix 7.5: Eviews Results for Estimated Coefficients from the Mean Equation**

| Return | **BNG** | p-val | **IND** | p-val | **PAK** | p-val | **SRLK** | p-val |
|---|---|---|---|---|---|---|---|---|
| $\mu$ | 0.0013* | 0.000 | 0.0020 | 0.095 | 0.0026* | 0.021 | 0.0013 | 0.207 |
| $\gamma\ (i,1)$ | 0.1558* | 0.000 | -0.0482 | 0.168 | 0.0148 | 0.607 | -0.0121 | 0.586 |
| $\gamma\ (i,2)$ | 0.0702* | 0.000 | 0.0166 | 0.652 | 0.0796* | 0.005 | 0.0254 | 0.288 |
| $\gamma\ (i,3)$ | 0.0154 | 0.150 | 0.0574 | 0.067 | 0.1271* | 0.000 | 0.0679* | 0.000 |
| $\gamma\ (i,4)$ | -0.0632* | 0.000 | 0.0059 | 0.884 | 0.0558 | 0.093 | 0.2183* | 0.000 |

* indicates significance at the five per cent level.

**Appendix 7.6: Estimated Coefficients for the Four Markets Multivariate GARCH model (Variance – Covariance Equation)**

| | **BNG(i =1)** | **IND(i =2)** | **PAK(i =3)** | **SRLK(i =4)** |
|---|---|---|---|---|
| α (*i*,1) | 0.9260* | 0.0227 | 0.0126 | -0.0368 |
| | (0.000) | (0.680) | (0.864) | (0.564) |
| α (*i*,2) | 0.0227 | 0.0885* | -0.0179 | 0.0398 |
| | (0.680) | (0.000) | (0.673) | (0.070) |
| α (*i*,3) | 0.0126 | -0.0179 | 0.3612* | 0.0379 |
| | (0.864) | (0.673) | (0.000) | (0.397) |
| α (*i*,4) | -0.0368 | 0.0398 | 0.0379 | 0.1382* |
| | (0.564) | (0.070) | (0.397) | (0.000) |
| g (*i*,1) | 0.5891* | 0.7208 | 0.4801 | 0.6916 |
| | (0.000) | (0.083) | (0.856) | (0.155) |
| g (*i*,2) | 0.7208 | 0.8887* | 0.6042 | 0.8564* |
| | (0.083) | (0.000) | (0.554) | (0.000) |
| g (*i*,3) | 0.4801 | 0.6042 | 0.4871* | 0.6068 |
| | (0.856) | (0.554) | (0.000) | (0.264) |
| g (*i*,4) | 0.6916 | 0.8564* | 0.6067 | 0.8332* |
| | (0.155) | (0.000) | (0.264) | (0.000) |

Figures in parenthesis indicate probability values. Coefficients α and g capture ARCH and GARCH effects in the multivariate GARCH-BEKK model. An * indicates significance at the five per cent level.

**Appendix 7.7: ARCH, GARCH and Constant Terms for Each Equation in the Variance - Covariance Matrix**

$$h_{11} = e_1^2 a_{11}^2 + 2e_1e_2a_{11}a_{21} + 2e_1e_3a_{11}a_{31} + 2e_1e_4a_{11}a_{41} + e_2^2a_{21}^2 + 2e_2e_3a_{21}a_{31} + 2e_2e_4a_{21}a_{41} + e_3^2a_{31}^2 + 2e_3e_4a_{31}a_{41} + e_4^2a_{41}^2$$

$$For\ g{:}\ h_{11} = h_{11}g_{11}^2 + 2h_{12}g_{11}g_{21} + 2h_{13}g_{11}g_{31} + 2h_{14}g_{11}g_{41} + h_{22}g_{21}^2 + 2h_{23}g_{21}a_{31} + 2h_{24}g_{21}g_{41} + h_{33}g_{31}^2 + 2h_{34}g_{31}g_{41} + h_{44}g_{41}^2$$

$$For\ C{:}\ h_{11} = c_{11}^2 + 2c_{11}c_{21} + 2c_{11}c_{31} + 2c_{11}c_{41} + c_{21}^2 + 2c_{21}c_{31} + 2c_{21}c_{41} + c_{31}^2 + 2c_{31}c_{41} + c_{41}^2$$

$$h_{21} = e_1^2a_{11}a_{12} + e_2^2a_{21}a_{22} + e_3^2a_{31}a_{32} + e_4^2a_{41}a_{42} + e_1e_2(a_{11}a_{22} + a_{12}a_{21}) + e_1e_3(a_{11}a_{32} + a_{12}a_{31}) + e_1e_4(a_{11}a_{42} + a_{12}a_{41})$$
$$+ e_2e_3(a_{21}a_{32} + a_{22}a_{31}) + e_2e_4(a_{21}a_{42} + a_{22}a_{41}) + e_3e_4(a_{31}a_{42} + a_{32}a_{41})$$

$$For\ g{:}\ h_{21} = h_{11}g_{11}g_{12} + h_{22}g_{21}g_{22} + h_{33}g_{31}g_{32} + h_{44}g_{41}g_{42} + h_{12}(g_{11}g_{22} + g_{12}g_{21}) + h_{13}(g_{11}g_{32} + g_{12}g_{31}) + h_{14}(g_{11}g_{42} + g_{12}g_{41})$$
$$+ h_{23}(g_{21}g_{32} + g_{22}g_{31}) + h_{24}(g_{21}g_{42} + g_{22}g_{41}) + h_{34}(g_{31}g_{42} + g_{32}g_{41})$$

$$h_{21} = c_{11}c_{12} + c_{21}c_{22} + c_{31}c_{32} + c_{41}c_{42} + c_{11}c_{22} + c_{12}c_{21} + c_{11}c_{32} + c_{12}c_{31} + c_{11}c_{42} + c_{12}c_{41} + c_{21}c_{32} + c_{22}c_{31} + c_{21}c_{42} + c_{22}c_{41} + c_{31}c_{42}$$
$$+ c_{32}c_{41}$$

$$h_{31} = e_1^2a_{11}a_{13} + e_2^2a_{21}a_{23} + e_3^2a_{31}a_{33} + e_4^2a_{41}a_{43} + e_1e_2(a_{11}a_{23} + a_{21}a_{13}) + e_1e_3(a_{11}a_{33} + a_{13}a_{31}) + e_1e_4(a_{11}a_{43} + a_{13}a_{41})$$
$$+ e_2e_3(a_{21}a_{33} + a_{31}a_{23}) + e_2e_4(a_{21}a_{43} + a_{23}a_{41}) + e_3e_4(a_{31}a_{43} + a_{41}a_{33})$$

$$for\ g: h_{31} = h_{11}g_{11}g_{13} + h_{22}g_{21}g_{23} + h_{33}g_{31}g_{33} + h_{44}g_{41}g_{43} + h_{12}(g_{11}g_{23} + g_{21}g_{13}) + h_{13}(g_{11}g_{33} + g_{13}g_{31}) + h_{14}(g_{11}g_{43} + g_{13}g_{41}) + h_{23}(g_{21}g_{33} + g_{31}g_{23}) + h_{24}(g_{21}g_{43} + g_{23}g_{41}) + h_{34}(g_{31}g_{43} + g_{41}g_{33})$$

$$h_{31} = c_{11}c_{13} + c_{21}c_{23} + c_{31}c_{33} + c_{41}c_{43} + c_{11}c_{23} + c_{13}c_{21} + c_{11}c_{33} + c_{13}c_{31} + c_{11}c_{43} + c_{13}c_{41} + c_{21}c_{33} + c_{23}c_{31} + c_{21}c_{43} + c_{23}c_{41} + c_{31}c_{43} + c_{33}c_{41}$$

$$h_{41} = e_1^2a_{11}a_{14} + e_2^2a_{21}a_{24} + e_3^2a_{31}a_{34} + e_4^2a_{41}a_{44} + e_1e_2(a_{11}a_{24} + a_{21}a_{14}) + e_1e_3(a_{11}a_{34} + a_{31}a_{14}) + e_1e_4(a_{11}a_{44} + a_{14}a_{41}) + e_2e_3(a_{21}a_{34} + a_{31}a_{24}) + e_2e_4(a_{21}a_{44} + a_{41}a_{24}) + e_3e_4(a_{31}a_{44} + a_{41}a_{34})$$

$$for\ g: h_{41} = h_{11}g_{11}g_{14} + h_{22}g_{21}g_{24} + h_{33}g_{31}g_{34} + h_{44}g_{41}g_{44} + h_{12}(g_{11}g_{24} + g_{21}g_{14}) + h_{13}(g_{11}g_{34} + g_{31}g_{14}) + h_{14}(g_{11}g_{44} + g_{14}g_{41}) + h_{23}(g_{21}g_{34} + g_{31}g_{24}) + h_{24}(g_{21}g_{44} + g_{41}g_{24}) + h_{34}(g_{31}g_{44} + g_{41}g_{34})$$

$$h_{41} = c_{11}c_{14} + c_{21}c_{24} + c_{31}c_{34} + c_{41}c_{44} + c_{11}c_{24} + c_{14}c_{21} + c_{11}c_{34} + c_{14}c_{31} + c_{11}c_{44} + c_{14}c_{41} + c_{21}c_{34} + c_{24}c_{31} + c_{21}c_{44} + c_{24}c_{41} + c_{31}c_{44} + c_{34}c_{41}$$

$$h_{12} = e_1^2a_{11}a_{12} + e_2^2a_{21}a_{22} + e_3^2a_{31}a_{32} + e_4^2a_{41}a_{42} + e_1e_2(a_{11}a_{22} + a_{12}a_{21}) + e_1e_3(a_{11}a_{32} + a_{12}a_{31}) + e_1e_4(a_{11}a_{42} + a_{12}a_{41}) + e_2e_3(a_{21}a_{32} + a_{22}a_{31}) + e_2e_4(a_{21}a_{42} + a_{22}a_{41}) + e_3e_4(a_{31}a_{42} + a_{32}a_{41})$$

$$For\ g: h_{12} = h_{11}g_{11}g_{12} + h_{22}g_{21}g_{22} + h_{33}g_{31}g_{32} + h_{44}g_{41}g_{42} + h_{12}(g_{11}g_{22} + g_{12}g_{21}) + h_{13}(g_{11}g_{32} + g_{12}g_{31}) + h_{14}(g_{11}g_{42} + g_{12}g_{41}) + h_{23}(g_{21}g_{32} + g_{22}g_{31}) + h_{24}(g_{21}g_{42} + g_{22}g_{41}) + h_{34}(g_{31}g_{42} + g_{32}g_{41})$$

$$h_{12} = c_{11}c_{12} + c_{21}c_{22} + c_{31}c_{32} + c_{41}c_{42} + c_{11}c_{22} + c_{12}c_{21} + c_{11}c_{32} + c_{12}c_{31} + c_{11}c_{42} + c_{12}c_{41} + c_{21}c_{32} + c_{22}c_{31} + c_{21}c_{42} + c_{22}c_{41} + c_{31}c_{42} + c_{32}c_{41}$$

$$h_{22} = e_1^2a_{12}^2 + 2e_1e_2a_{12}a_{22} + 2e_1e_3a_{12}a_{32} + 2e_1e_4a_{12}a_{42} + e_2^2a_{22}^2 + 2e_2e_3a_{22}a_{32} + 2e_2e_4a_{22}a_{42} + e_3^2a_{32}^2 + 2e_3e_4a_{32}a_{42} + e_4^2a_{42}^2$$

$$For\ g: h_{22} = h_{11}g_{12}^2 + 2h_{12}g_{12}g_{22} + 2h_{13}g_{12}g_{32} + 2h_{14}g_{12}g_{42} + h_{22}g_{22}^2 + 2h_{23}g_{22}a_{32} + 2h_{24}g_{22}g_{42} + h_{33}g_{32}^2 + 2h_{34}g_{32}g_{42} + h_{44}g_{42}^2$$

$$For\ C: h_{22} = c_{12}^2 + 2c_{12}c_{22} + 2c_{12}c_{32} + 2c_{12}c_{42} + c_{22}^2 + 2c_{22}c_{32} + 2c_{22}c_{42} + c_{32}^2 + 2c_{32}c_{42} + c_{42}^2$$

$$h_{32} = e_1^2a_{12}a_{13} + e_2^2a_{22}a_{23} + e_3^2a_{32}a_{33} + e_4^2a_{42}a_{43} + e_1e_2(a_{12}a_{23} + a_{13}a_{22}) + e_1e_3(a_{12}a_{33} + a_{13}a_{32}) + e_1e_4(a_{12}a_{43} + a_{13}a_{42}) + e_2e_3(a_{22}a_{33} + a_{23}a_{32}) + e_2e_4(a_{22}a_{43} + a_{23}a_{42}) + e_3e_4(a_{32}a_{43} + a_{33}a_{42})$$

$$For\ g: h_{32} = h_{11}g_{12}g_{13} + h_{22}g_{22}g_{23} + h_{33}g_{32}g_{33} + h_{44}g_{42}g_{43} + h_{12}(g_{13}g_{23} + g_{13}g_{22}) + h_{13}(g_{12}g_{33} + g_{13}g_{32}) + h_{14}(g_{12}g_{43} + g_{13}g_{42}) + h_{23}(g_{22}g_{33} + g_{23}g_{32}) + h_{24}(g_{22}g_{43} + g_{23}g_{42}) + h_{34}(g_{32}g_{43} + g_{33}g_{42})$$

$$For\ C: h_{32} = c_{12}c_{13} + c_{22}c_{23} + c_{33}c_{32} + c_{43}c_{42} + c_{13}c_{23} + c_{13}c_{22} + c_{12}c_{33} + c_{13}c_{32} + c_{12}c_{43} + c_{13}c_{42} + c_{22}c_{33} + c_{23}c_{32} + c_{22}c_{43} + c_{23}c_{42} + c_{32}c_{43} + c_{33}c_{42}$$

$$h_{42} = e_1^2 a_{12}a_{14} + e_2^2 a_{22}a_{24} + e_3^2 a_{32}a_{34} + e_4^2 a_{42}a_{44} + e_1e_2(a_{12}a_{24} + a_{14}a_{22}) + e_1e_3(a_{12}a_{34} + a_{14}a_{32}) + e_1e_4(a_{12}a_{44} + a_{14}a_{42})$$

$$+ e_2e_3(a_{22}a_{34} + a_{24}a_{32}) + e_2e_4(a_{22}a_{44} + a_{24}a_{42}) + e_3e_4(a_{32}a_{44} + a_{34}a_{42})$$

$$For\ g: h_{42} = h_{11}g_{12}g_{14} + h_{22}g_{22}g_{24} + h_{33}g_{32}g_{34} + h_{44}g_{42}g_{44} + h_{12}(g_{13}g_{24} + g_{14}g_{22}) + h_{13}(g_{12}g_{34} + g_{14}g_{32}) + h_{14}(g_{12}g_{44} + g_{14}g_{42})$$

$$+ h_{23}(g_{22}g_{34} + g_{24}g_{32}) + h_{24}(g_{22}g_{44} + g_{24}g_{42}) + h_{34}(g_{32}g_{44} + g_{34}g_{42})$$

$$For\ C: h_{42} = c_{12}c_{14} + c_{22}c_{24} + c_{34}c_{32} + c_{44}c_{42} + c_{13}c_{24} + c_{14}c_{22} + c_{12}c_{34} + c_{14}c_{32} + c_{12}c_{44} + c_{14}c_{42} + c_{22}c_{34} + c_{24}c_{32} + c_{22}c_{44} + c_{24}c_{42}$$

$$+ c_{32}c_{44} + c_{34}c_{42}$$

$$h_{13} = e_1^2 a_{11}a_{13} + e_2^2 a_{21}a_{23} + e_3^2 a_{31}a_{33} + e_4^2 a_{41}a_{43} + e_1e_2(a_{11}a_{23} + a_{21}a_{13}) + e_1e_3(a_{11}a_{33} + a_{13}a_{31}) + e_1e_4(a_{11}a_{43} + a_{13}a_{41})$$

$$+ e_2e_3(a_{21}a_{33} + a_{31}a_{23}) + e_2e_4(a_{21}a_{43} + a_{23}a_{41}) + e_3e_4(a_{31}a_{43} + a_{41}a_{33})$$

$$for\ g: h_{13} = h_{11}g_{11}g_{13} + h_{22}g_{21}g_{23} + h_{33}g_{31}g_{33} + h_{44}g_{41}g_{43} + h_{12}(g_{11}g_{23} + g_{21}g_{13}) + h_{13}(g_{11}g_{33} + g_{13}g_{31}) + h_{14}(g_{11}g_{43} + g_{13}g_{41})$$

$$+ h_{23}(g_{21}g_{33} + g_{31}g_{23}) + h_{24}(g_{21}g_{43} + g_{23}g_{41}) + h_{34}(g_{31}g_{43} + g_{41}g_{33})$$

$$For\ C: h_{13} = c_{11}c_{13} + c_{21}c_{23} + c_{31}c_{33} + c_{41}c_{43} + c_{11}c_{23} + c_{13}c_{21} + c_{11}c_{33} + c_{13}c_{31} + c_{11}c_{43} + c_{13}c_{41} + c_{21}c_{33} + c_{23}c_{31} + c_{21}c_{43} + c_{23}c_{41}$$

$$+ c_{31}c_{43} + c_{33}c_{41}$$

$$h_{23} = e_1^2 a_{12}a_{13} + e_2^2 a_{22}a_{23} + e_3^2 a_{32}a_{33} + e_4^2 a_{42}a_{43} + e_1e_2(a_{12}a_{23} + a_{13}a_{22}) + e_1e_3(a_{12}a_{33} + a_{13}a_{32}) + e_1e_4(a_{12}a_{43} + a_{13}a_{42})$$
$$+ e_2e_3(a_{22}a_{33} + a_{23}a_{32}) + e_2e_4(a_{22}a_{43} + a_{23}a_{42}) + e_3e_4(a_{32}a_{43} + a_{33}a_{42})$$

$$For\ g: h_{23} = h_{11}g_{12}g_{13} + h_{22}g_{22}g_{23} + h_{33}g_{32}g_{33} + h_{44}g_{42}g_{43} + h_{12}(g_{13}g_{23} + g_{13}g_{22}) + h_{13}(g_{12}g_{33} + g_{13}g_{32}) + h_{14}(g_{12}g_{43} + g_{13}g_{42})$$
$$+ h_{23}(g_{22}g_{33} + g_{23}g_{32}) + h_{24}(g_{22}g_{43} + g_{23}g_{42}) + h_{34}(g_{32}g_{43} + g_{33}g_{42})$$

$$For\ C: h_{23} = c_{12}c_{13} + c_{22}c_{23} + c_{33}c_{32} + c_{43}c_{42} + c_{13}c_{23} + c_{13}c_{22} + c_{12}c_{33} + c_{13}c_{32} + c_{12}c_{43} + c_{13}c_{42} + c_{22}c_{33} + c_{23}c_{32} + c_{22}c_{43} + c_{23}c_{42}$$
$$+ c_{32}c_{43} + c_{33}c_{42}$$

$$h_{33} = e_1^2 a_{13}^2 + 2e_1e_2a_{13}a_{23} + 2e_1e_3a_{13}a_{33} + 2e_1e_4a_{13}a_{43} + e_2^2a_{23}^2 + 2e_2e_3a_{23}a_{33} + 2e_2e_4a_{23}a_{43} + e_3^2a_{33}^2 + 2e_3e_4a_{33}a_{43} + e_4^2a_{43}^2$$

$$For\ g: h_{33} = h_{11}g_{13}^2 + 2h_{12}g_{13}g_{23} + 2h_{13}g_{13}g_{33} + 2h_{14}g_{13}g_{43} + h_{22}g_{23}^2 + 2h_{23}g_{23}a_{33} + 2h_{24}g_{23}g_{43} + h_{33}g_{33}^2 + 2h_{34}g_{33}g_{43} + h_{44}g_{43}^2$$

$$For\ C: h_{33} = c_{13}^2 + 2c_{13}c_{23} + 2c_{13}c_{33} + 2c_{13}c_{43} + c_{23}^2 + 2c_{23}c_{33} + 2c_{23}c_{43} + c_{33}^2 + 2c_{33}c_{43} + c_{43}^2$$

$$h_{43} = e_1^2 a_{13}a_{14} + e_2^2 a_{23}a_{24} + e_3^2 a_{33}a_{34} + e_4^2 a_{43}a_{44} + e_1e_2(a_{13}a_{24} + a_{14}a_{23}) + e_1e_3(a_{13}a_{34} + a_{14}a_{33}) + e_1e_4(a_{13}a_{44} + a_{14}a_{43})$$
$$+ e_2e_3(a_{23}a_{34} + a_{24}a_{33}) + e_2e_4(a_{23}a_{44} + a_{24}a_{43}) + e_3e_4(a_{33}a_{44} + a_{34}a_{43})$$

$$For\ g: h_{43} = h_{11}g_{13}g_{14} + h_{22}g_{23}g_{24} + h_{33}g_{33}g_{34} + h_{44}g_{43}g_{44} + h_{12}(g_{13}g_{24} + g_{14}g_{23}) + h_{13}(g_{13}g_{34} + g_{14}g_{33}) + h_{14}(g_{13}g_{44} + g_{14}g_{43})$$
$$+ h_{23}(g_{23}g_{34} + g_{24}g_{33}) + h_{24}(g_{23}g_{44} + g_{24}g_{43}) + h_{34}(g_{33}g_{44} + g_{34}g_{43})$$

$$For\ C: h_{43} = c_{13}c_{14} + c_{23}c_{24} + c_{33}c_{34} + c_{43}c_{44} + c_{13}c_{24} + c_{14}c_{23} + c_{13}c_{34} + c_{14}c_{33} + c_{13}c_{44} + c_{14}c_{43} + c_{23}c_{34} + c_{24}c_{33} + c_{23}c_{44} + c_{24}c_{43} + c_{33}c_{44} + c_{34}c_{43}$$

$$h_{14} = e_1^2 a_{11}a_{14} + e_2^2 a_{21}a_{24} + e_3^2 a_{31}a_{34} + e_4^2 a_{41}a_{44} + e_1e_2(a_{11}a_{24} + a_{21}a_{14}) + e_1e_3(a_{11}a_{34} + a_{31}a_{14}) + e_1e_4(a_{11}a_{44} + a_{14}a_{41}) + e_2e_3(a_{21}a_{34} + a_{31}a_{24}) + e_2e_4(a_{21}a_{44} + a_{41}a_{24}) + e_3e_4(a_{31}a_{44} + a_{41}a_{34})$$

$$for\ g: h_{14} = h_{11}g_{11}g_{14} + h_{22}g_{21}g_{24} + h_{33}g_{31}g_{34} + h_{44}g_{41}g_{44} + h_{12}(g_{11}g_{24} + g_{21}g_{14}) + h_{13}(g_{11}g_{34} + g_{31}g_{14}) + h_{14}(g_{11}g_{44} + g_{14}g_{41}) + h_{23}(g_{21}g_{34} + g_{31}g_{24}) + h_{24}(g_{21}g_{44} + g_{41}g_{24}) + h_{34}(g_{31}g_{44} + g_{41}g_{34})$$

$$h_{14} = c_{11}c_{14} + c_{21}c_{24} + c_{31}c_{34} + c_{41}c_{44} + c_{11}c_{24} + c_{14}c_{21} + c_{11}c_{34} + c_{14}c_{31} + c_{11}c_{44} + c_{14}c_{41} + c_{21}c_{34} + c_{24}c_{31} + c_{21}c_{44} + c_{24}c_{41} + c_{31}c_{44} + c_{34}c_{41}$$

$$h_{24} = e_1^2 a_{12}a_{14} + e_2^2 a_{22}a_{24} + e_3^2 a_{32}a_{34} + e_4^2 a_{42}a_{44} + e_1e_2(a_{12}a_{24} + a_{14}a_{22}) + e_1e_3(a_{12}a_{34} + a_{14}a_{32}) + e_1e_4(a_{12}a_{44} + a_{14}a_{42}) + e_2e_3(a_{22}a_{34} + a_{24}a_{32}) + e_2e_4(a_{22}a_{44} + a_{24}a_{42}) + e_3e_4(a_{32}a_{44} + a_{34}a_{42})$$

$$For\ g: h_{24} = h_{11}g_{12}g_{14} + h_{22}g_{22}g_{24} + h_{33}g_{32}g_{34} + h_{44}g_{42}g_{44} + h_{12}(g_{13}g_{24} + g_{14}g_{22}) + h_{13}(g_{12}g_{34} + g_{14}g_{32}) + h_{14}(g_{12}g_{44} + g_{14}g_{42}) + h_{23}(g_{22}g_{34} + g_{24}g_{32}) + h_{24}(g_{22}g_{44} + g_{24}g_{42}) + h_{34}(g_{32}g_{44} + g_{34}g_{42})$$

$$For\ C: h_{24} = c_{12}c_{14} + c_{22}c_{24} + c_{34}c_{32} + c_{44}c_{42} + c_{13}c_{24} + c_{14}c_{22} + c_{12}c_{34} + c_{14}c_{32} + c_{12}c_{44} + c_{14}c_{42} + c_{22}c_{34} + c_{24}c_{32} + c_{22}c_{44} + c_{24}c_{42} + c_{32}c_{44} + c_{34}c_{42}$$

$$h_{34} = e_1^2a_{13}a_{14} + e_2^2a_{23}a_{24} + e_3^2a_{33}a_{34} + e_4^2a_{43}a_{44} + e_1e_2(a_{13}a_{24} + a_{14}a_{23}) + e_1e_3(a_{13}a_{34} + a_{14}a_{33}) + e_1e_4(a_{13}a_{44} + a_{14}a_{43}) + e_2e_3(a_{23}a_{34} + a_{24}a_{33}) + e_2e_4(a_{23}a_{44} + a_{24}a_{43}) + e_3e_4(a_{33}a_{44} + a_{34}a_{43})$$

$$For\ g: h_{34} = h_{11}g_{13}g_{14} + h_{22}g_{23}g_{24} + h_{33}g_{33}g_{34} + h_{44}g_{43}g_{44} + h_{12}(g_{13}g_{24} + g_{14}g_{23}) + h_{13}(g_{13}g_{34} + g_{14}g_{33}) + h_{14}(g_{13}g_{44} + g_{14}g_{43}) + h_{23}(g_{23}g_{34} + g_{24}g_{33}) + h_{24}(g_{23}g_{44} + g_{24}g_{43}) + h_{34}(g_{33}g_{44} + g_{34}g_{43})$$

$$For\ C: h_{34} = c_{13}c_{14} + c_{23}c_{24} + c_{33}c_{34} + c_{43}c_{44} + c_{13}c_{24} + c_{14}c_{23} + c_{13}c_{34} + c_{14}c_{33} + c_{13}c_{44} + c_{14}c_{43} + c_{23}c_{34} + c_{24}c_{33} + c_{23}c_{44} + c_{24}c_{43} + c_{33}c_{44} + c_{34}c_{43}$$

$$h_{44} = e_1^2a_{14}^2 + 2e_1e_2a_{14}a_{24} + 2e_1e_3a_{14}a_{34} + 2e_1e_4a_{14}a_{44} + e_2^2a_{24}^2 + 2e_2e_3a_{24}a_{34} + 2e_2e_4a_{24}a_{44} + e_3^2a_{34}^2 + 2e_3e_4a_{34}a_{44} + e_4^2a_{44}^2$$

$$For\ g: h_{44} = h_{11}g_{14}^2 + 2h_{12}g_{14}g_{24} + 2h_{13}g_{14}g_{34} + 2h_{14}g_{14}g_{44} + h_{22}g_{24}^2 + 2h_{23}g_{24}a_{34} + 2h_{24}g_{24}g_{44} + h_{33}g_{34}^2 + 2h_{34}g_{34}g_{44} + h_{44}g_{44}^2$$

$$For\ C: h_{44} = c_{14}^2 + 2c_{14}c_{24} + 2c_{14}c_{34} + 2c_{14}c_{44} + c_{24}^2 + 2c_{24}c_{34} + 2c_{24}c_{44} + c_{34}^2 + 2c_{34}c_{44} + c_{44}^2$$

# Bibliography

Abdalla, I.S.A. & Murinde, V. (1997). Exchange rate and stock price interactions in emerging financial markets: evidence on India, Korea, Pakistan and the Philippines. Applied Financial Economics, 7, 25-35.

Abiad, A. & Mody, A. (2005). Financial Reform: What Shakes It? What Shapes It? The American Economic Review, 95. 66-88.

Acikalin, S. Aktas, R. & Unal, S. (2008). Relationships between stock markets and macroeconomic variables: an empirical analysis of the Istanbul Stock Exchange. Investment Management and Financial Innovations, 5, 1, 8-16.

Aggarwal, R., & Kyaw, N.N.A. (2005). Equity market integration in the NAFTA region: Evidence from unit root and cointegration tests. International Review of Financial Analysis, 14, 393-406.

Aggarwal, R., Inclan, C. & Leal, R. (1999). Volatility in Emerging Stock Markets. The Journal of Financial and Quantitative Analysis, 34. 33- 55.

Ahmed, M.N. & Imam, M.O. (2007). Macroeconomic Factors and Bangladesh Stock Market: Impact Analysis through Cointegration Approach. International Review of Business Research Papers, 3, 5, 21-35.

Ahmed, S. (2008), Aggregate Economic Variables and Stock Markets in India. International Research Journal of Finance and Economics, 14, 141-164.

Ahmed, S. & Farooq, O. (2008). The effect of 9/11 on stock market volatility dynamics: empirical evidence from a front line state. International Research Journal of Finance and Economics, 16, 71-83.

Ajayi, R. A. & Mougoue, M. (1996). On the dynamic relation between stock prices and exchange rates. Journal of Financial Research, 19, 193-207.

Al-Abdulqader, K.A., Hannah, G. & Power, D.M. (2007). The appraisal of ordinary shares by Saudi investors. Research in International Business and Finance, 21. 69–86.

Alexander, C. (2001). Market Models: A Guide to Financial Data Analysis. John Wiley & Sons.

Al-Khazali, O. Darrat, A.F. & Saad, M. (2006) Intra-regional integration of the GCC stock markets: the role of market liberalization. Applied Financial Economics, 16, 17, 1265-1272.

Alkulaib, Y.A., Najand, M. & Mashayekh, A. (2009). Dynamic linkages among equity markets in the Middle East and North African countries. Journal of Multinational Financial Management, 19, 43-53.

Andersen, T.G. & Bollerslev, T. (1998). Answering the sceptics: Yes, standard volatility models do provide accurate forecasts. International Economic Review, 39, 885-905.

Arnold, G. (2008). Corporate Financial Management. FT Pearson Education, 4th Edition.

Arshanapalli, B. & Doukas, J. (1993). International stock market linkages: Evidence from the pre- and post- October 1987 period. Journal of Banking and Finance, 17, 193-208.

Arshanapalli, B., Doukas, J. & Lang, L. (1995). Pre and post-October 1987 stock market linkages between U.S. and Asian markets. Pacific-Basin Finance Journal, 3, 57-73.

Asian Stock Markets Factbook, (1994-1995). An Institute of Securities Institute (ISI), Publication.

Bailey, W. & Stulz, R.M. (1990). Benefits of international diversification: the case of Pacific Basin stock markets. Journal of Portfolio Management, 16, 57–61.

Baillie, R.T. & Bollerslev, T. (1989). The message in daily exchange rates: A conditional variance tale. Journal of Business and Economic Statistics, 7, 297-305.

Ball, R. & Brown, P. (1968). An empirical evaluation of accounting income numbers, Journal of Accounting Research, 6, 2, 159-178.

Bauwens, L., Laurent, S. & Rombouts, J. V. K. (2006). Multivariate GARCH Models: A Survey, Journal of Applied Econometrics 21, 79-109.

Bekaert, G. & Harvey, C.R. (2002). Research in Emerging Market Finance: Looking to the Future. Emerging Markets Review, 1, 429–448.

Bekaert, G. (1995). Market Integration and Investment Barriers in Emerging Equity Markets. The World Bank Economic Review, 9, 1, 75-107.

Bekaert, G. & Harvey, C.R. (1995). Time-varying World Market Integration, Journal of Finance, 50, 403-444.

Bekaert, G. & Urias, M. (1999). Is there a free lunch in emerging market equities? Journal of Portfolio Management, 25, 83-95.

Bekaert, G., Harvey, C.R. & Lundblad, C.T. (2003). Equity market liberalisation in emerging markets. The Journal of Financial Research, 26, 275-299.

Bessler, D.A. & Yang, J. (2003). The structure of interdependence in international stock markets. Journal of International Money and Finance 22, 261–287.

Bhaskaran, M. (2009). The Impact of the Global Economic Slowdown on South Asia. Global Journal of Emerging Market Economies, 1: 159-239.

Bhattacharya, D. (2002). State of the Bangladesh Economy. Centre for Policy Dialogue, Independent Review of Bangladesh's Development, (IRBD).

Bilson, C.M., Brailsford, T.J. & Hooper, V.J. (2001). Selecting macroeconomic variables as explanatory factors of emerging stock market returns. Pacific-Basin Finance Journal 9, 401–426.

Bodie, Z., Kane, A. & Marcus, A.J. (1996). Investments. Richard D. Irwin, A Time Mirror Higher Education Group, Publication, 3rd Edition.

Bodurtha, J.N., Cho, D.C. & Senbet, L.N. (1989). Economic forces and the stock market: An International Perspective. Global Finance Journal, 1, 1, 21-46.

Bollerslev, T., Engle, R. F. & Wooldridge, J.M. (1988). A capital asset pricing model with time-varying covariances. Journal of Political Economy, 96, 116-131.

Bollerslev, T. & Wooldridge, J.M. (1992). Quasi-maximum likelihood estimation and inference in dynamic models with time-varying covariances. Econometric Reviews, 11, 143-172.

Booth, C.G., Martikainen, T. & Tse, Y. (1997). Price and volatility spillovers in Scandinavian stock markets. Journal of Banking and Finance, 21, 811-823.

Bowman, R.G. & Comer, M.R. (2000). The reaction of world equity markets to the Asian economic crisis. Working paper, University of Aukland.

Brooks, C. (2008). Introductory Econometrics for Finance. 2nd Edition, Cambridge University Press.

Bryman, A. (2004). Social Research Methods. 2nd Edition, Oxford University Press.

Bryman, A. (2008).Social Research Methods. 3rd Edition, Oxford University Press.

Burrell, G. & Morgan, G., (1979). Sociological Paradigms and Organizational Analysis. Heinemann: London.

Cagliarini, A. & Baker, M. (2010). Economic Change in India, RBA Bulletin, September, 19-24.

Campbell, J. Y., Lo, A. W. & MacKinlay, A. C. (1997). The Econometrics of Financial Markets, Princeton University Press, Princeton, NJ.

Chan, K., Covrig, V. & Ng, L. (2005). What Determines the Domestic Bias and Foreign Bias? Evidence from Mutual Fund Equity Allocations Worldwide. The Journal of Finance, LX, 3, 1495-1534.

Chan, K.C., Gup, B.E. & Pan, M.S. (1992). An empirical analysis of stock prices in major Asian markets and the United States. The Financial Review, 27, 289-307.

Chan, K.C., Gup, B.E. & Pan, M.S. (1997). International stock market efficiency and integration: a study of eighteen nations. Journal of Business Finance & Accounting, 24, 803-813.

Chan, K., Karolyi, A. & Stultz, R. (1992). Global Financial Markets and the Risk Premium on US equity. Journal of Financial Economics 32, 137–167.

Charles, A., Darne', O. (2006). Large shocks and the September 11th terrorist attacks on international stock markets. Economic Modelling, 23, 683-698.

Chen, G.M., Firth, M. & Rui, O.M. (2002). Stock market linkages: Evidence from Latin America. Journal of Banking and Finance, 26, 1113-1141.

Chen, N., Roll, R. & Ross, S.A. (1986). Economic forces and the stock market. Journal of Business, 59, 3, 383-403.

Cheung, Y. L. & Mak, S. C. (1992). The international transmission of stock market fluctuations between the developed markets and the Asian-Pacific markets. Applied Financial Economics, 2, 43-47.

Cheung, Y.W. & Ng. L.K. (1998). International evidence on the stock market and aggregate economic activity, Journal of Empirical Finance, 5 281–296.

Chiou, W.J.P., Lee, A.C. & Chang, C.C.A. (2009). Do investors still benefit from international diversification with investment constraints? The Quarterly Review of Economics and Finance, 49, 448-483.

Chou, R.Y., Lin, J.L. & Wu, C.S. (1999). Modelling the Taiwan Stock Market and International Linkages. Pacific Economic Review, 4, 3, 305-320.

Choudhary, T. (2001) Inflation and rates of return on stocks: evidence from high inflation countries. Journal of International Financial Markets, Institutions and Money, 11, 75–96.

Chua, F. (1986). Radical Developments in Accounting Thought. Accounting Review, 61: 601-632.

Chuang, I-Y., Lu, J.R. & Tswei, K. (2007). Interdependence of international equity variances: Evidence from East Asian markets. Emerging Markets Review, 8, 311-327.

Chung, P. & Liu, D. (1994). Common stochastic trends in Pacific Rim stock markets. The Quarterly Review of Economics and Finance, 34, 241-259.

Claessens, S., Dasgupta, S. & Glen, J. (1995). Return behaviour in emerging stock markets. The World Bank Economic Review, 9, 131-151.

Click, R.W. & Plummer, M.G. (2005). Stock market integration in ASEAN after the Asian financial crises. Journal of Asian Economics, 16, 5-28.

Cooley, T. & LeRoy, S. (1985). A Theoretical Macro Econometrics: A Critique. Journal of Monetary Economics 16, 283–308.

Dahrendorf, R. (1959). Class and Class Conflict in Industrial Society. Stanford University Press Stanford, California.

Daily the Nation, July (2010). Power Failure Halts Business.

De Roon, F.A., Nijman, T.E. & Werker, B.J.M.. (2001). Testing for mean – variance spanning with short sales constraints and transaction costs: the case of emerging markets. Journal of Finance 56, 721-742.

Desai, V.V. (2010). The Political Economy of Regional Cooperation in South Asia. ADB Working Paper Series on Regional Economic Integration, 54.

Devarajan, S. & Nabi, I. (2006). Economic Growth in South Asia: Promising, Un-equalising…Sustainable? Washington DC. The World Bank. 20433.

Dhrymes, P.J. I., Gültekin, F.M.N. & Gültekin, N.B. (1985). New Tests of the APT and Their Implications. The Journal of Finance, 40, 659-675.

Diamandis, P.F. (2009). International stock market linkages: Evidence from Latin America. Global Finance Journal, 20, 13-30.

Dickey, D.A. & Fuller, W.A. (1979). Distribution of the estimators for autoregressive time series with a unit root. Journal of the American Statistical Association, 74, 427-431.

Divecha, A.B., Drach, J. & Stefek, D. (1992). Emerging markets: a quantitative perspective. Journal of Portfolio Management. 18. 41–50.

Doornik, J. A. (1998). Approximations to the asymptotic distribution of cointegration tests. Journal of Economic Surveys *12*, 573–593.

Driessen, J., & Luc Laeven, L. (2007). International portfolio diversification benefits: Cross-country evidence from a local perspective. Journal of Banking & Finance 31, 1693–1712.

Dunteman, G.H. (1994). Principal Components Analysis, in: M.S. Lewis-Beck, ed., Factor Analysis and Related Techniques, International Handbooks of Quantitative Applications in the Social Sciences, 5, Sage Publications London, 157-245.

Eissa, M.A., Chortareas, G. & Cipollini, A. (2010). Stock Returns and Exchange Rate Volatility Spillovers in the MENA Region. Journal of Emerging Market Finance, 9, 3, 257-284.

Elyasiani, E., Perera, P. & Puri, T.N. (1998). Interdependence and dynamic linkages between stock market of Sri Lanka and its trading partners. Journal of Multinational Financial Management, 8, 89-101.

Engle, R. (1982). Autoregressive conditional heteroscedasticity with estimates of the variance of UK inflation. Econometrica, 50, 987–1008.

Engle, R.F. & Granger, C.W.J. (1987). Cointegration and error correction: Representation estimation and testing. Econometrica, 55, 251-276.

Engle, R.F. & Kroner, K.F. (1995). Multivariate simultaneous generalized ARCH. Econometric Theory, 11, 122-150.

Erdinc, H. & Milla, J. (2009). Analysis of cointegration in capital markets of France, Germany and United Kingdom. Economics and Business Journal: Inquiries & Perspectives, 2, 1, 109-123.

Errunza, V.R. (1977). Gains from portfolio diversification into less developed countries' securities. Journal of International Business Studies, 83-99.

Errunza, V.R. (1983). Emerging Markets: A New Opportunity for Improving Global Portfolio Performance. Financial Analysts Journal, 39, 5, 51-58.

Errunza, V.R. (1994). Emerging Markets: Some New Concepts. Journal of Portfolio Management, 20, 82-87.

Errunza, V.R. (1997). Research on emerging markets: past, present, and future. Emerging Markets Quarterly, 5-18.

Errunza, V., Hogan, K. & Hung, M.W. (1999). Have the gains from international diversification disappeared? Journal of Finance 54, 2075– 2107.

Errunza, V.R. & Padmanabhan, P. (1988). Further evidence on the benefits of portfolio investment in emerging markets. Financial Analysts Journal, 44, 76-78.

Eun, C. & Shim, S. (1989). International transmission of stock market movements. Journal of Financial and Quantitative Analysis 24, 241–256.

Fama, E.F. (1965). The Behaviour of Stock-Market Prices. The Journal of Business, 38, 1, 34-105.

Fama, E.F. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work. The Journal of Finance, 25, 2, 383-417.

Fama, E.F. (1981). Stock Returns, Real Activity, Inflation and Money. American Economic Review, 71, 4, 545-565.

Fifield, S.G.M., Lonie, A. A. & Power, D.M. (1998). A review of research into emerging stock markets. Economic Issues, 3, 1-35.

Fifield, S.G.M., Lonie, A.A. & Power, D.M. (2002). Emerging stock markets: A more realistic assessment of the gains from diversification. Applied Financial Economics. 12, 213-219.

Fifield, S.G.M., Lonie, A.A., Power, D.M. & Sinclair, C.D. (1999). Emerging markets: a disaggregated perspective on the gains from investing internationally. Review of Pacific Basin Financial Markets and Policies, 2. 99–124.

Fifield, S.G.M. & Power, D.M. (2006). The role of economic and fundamental factors in emerging market share returns: A comparison of Asian and Non-Asian countries. Journal of Accounting and Finance, 5. 1-18.

Fifield, S.G.M., Power, D.M. & Sinclair, C.D. (2002). Macroeconomic Factors and Share Returns: An Analysis Using Emerging Market Data, International Journal of Finance and Economics, 7, 51-62.

*Financial Times (2008)*. “Opposition in Push for Pakistan Elections” January 2..

Flannery, M. J. & Protopapadakis, A. A. (2002). Macroeconomic factors do influence aggregate stock returns, The Review of Financial Studies, 15, 3, 751-782.

Fletcher, J. & Marshall, A. (2005). An empirical examination of the benefits of international diversification. International Financial Markets, Institutions and Money, 15, 455–468.

Fraser, P., & Oyefeso, O. (2005). US, UK and European Stock Market Integration. Journal of Business Finance & Accounting, 32(1) & (2) 161-181.

Gay, R.D. Jr. (2008). Effect of Macroeconomic Variables on Stock Market Returns for Four Emerging Economies: Brazil, Russia, India, and China. International Business and Economics Research Journal 7, 31.

Gebka, B. & Serwa, D. (2007). Intra- and inter-regional spillovers between emerging capital markets around the world. Research in International Business and Finance 21,2, 203-221.

Gilmore, C.G. & McManus, G.M. (2002). International portfolio diversification: US and Central European equity markets. Emerging Markets Review, 3, 69-83.

Godfrey, J., Hodgson, A. & Holmes, S. (2000). Accounting Theory, 4th, Edition, Wiley.

Goldberg, C.S. & Francisco A. Delgado, F.A. (2001). Financial Integration of Emerging Markets: An Analysis of Latin America versus South Asia Using Individual Stocks. Multinational Finance Journal, 5, 4, 259–301.

Granger, C.W.J. (1986). Developments in the study of cointegrated economic variables. Oxford Bulletin of Economics and Statistics, 48, 213-228.

Granger, C.W.J. (1988). Some recent developments in a concept of causality, Journal of Econometrics, 39, 199-211.

Grubel, H.G. (1968). Internationally diversified portfolios: welfare gains and capital flows, The American Economic Review. 58, 1299-1314.

Gujarati, D. (2004). Basic Econometrics, 4th Edition, McGraw Hill, New York.

Gunasekarage, A. & Power, D.M. (2001). The profitability of moving average trading rules in South Asian stock markets. Emerging Markets Review 2. 17-33.

Gunasekarage, A., Pisedtasalasai, A. & Power, D.M. (2004). Macroeconomic influences on the stock market: Evidence from an emerging market in South Asia. Journal of Emerging Market Finance, 3, 285-304.

Hakkio, G.S. & Rush, M. (1991). Cointegration: How short is the long run? Journal of International Money and Finance, 10, 571-581.

Hamao, Y., Masulis, R. & Ng, V. (1990). Correlations in Price Changes and Volatility across International Stock Markets, Review of Financial Studies, 3, 281-307.

Hammoudeh, S., & Li, H. (2008). Sudden changes in volatility in emerging markets: the case of Gulf Arab stock markets. International Review of Financial Analysis, 17, 47-63.

Harris, R.D.F. & Pisedtasalasai, A. (2006). Return and volatility spillovers between large and small stocks in the UK. Journal of Business Finance and Accounting, 33, 1-16.

Hartmann, M.A. & Khambata, D. (1993). Emerging stock markets: Investment strategies of the future. Columbia Journal of World Business, 82-104.

Harvey, C.A. (1995a). The risk exposure of emerging equity markets. The World Bank Economic Review, 9, 1, 19-50.

Harvey, C.A. (1995b). Predictable risk and returns in emerging markets. Review of Financial Studies, 8, 3, 773-816.

Hasbrouck, J. (1995). One security, many markets: determining the contributions to price discovery. Journal of Finance, 50, 1175-1199.

Hassan, S.A. & Malik, F. (2007). Multivariate GARCH modelling of sector volatility transmission. The Quarterly Review of Economics and Finance, 47, 470-480.

Helliar, C.V., Power, D.M., Lonie, A.A. & Sinclair, C.D. (2000). The risks of investing in emerging markets; fund managers' perspectives. Journal of European Financial Services, 4. 1. 7-30.

Henry, P.B. (2000a). Stock market liberalization, economic reform, and emerging market equity prices. Journal of  Finance 55, 529–564.

Henry, P.B. (2000b). Do stock market liberalizations cause investment booms? Journal of Financial Economics. 58, 301–334.

Herrero, A.G. & Wooldridge, P. (2007). Global and regional financial integration: progress in emerging markets. BIS Quarterly Review, 57- 70.

Hondroyiannis, G., & Papapetrou, E. (2001). Macroeconomic influences on the stock market. Journal of Economics and Finance, 25, 1, 33-49.

Hossain, S.A. (2009). South Asian Free Trade Area: Implications for Bangladesh. MPRA Working Paper No. 18517.

Hotelling, H. (1933). Analysis of Complex Statistical Variables into Principal Components. Journal of Educational Psychology, 24, 417-441.

Huang, B.N., Yang, C.W. & Hu, J.W.S. (2000). Causality and cointegration of stock markets among the United States, Japan, and the South China Growth Triangle. International Review of Financial Analysis, 9, 281-297.

Humpe, A. & Macmillan, P. (2009). Can macroeconomic variables explain long-term stock market movements? A comparison of the US and Japan. Applied Financial Economics, 19, 2, 111-119.

Hung, B. & Cheung, Y. (1995). Interdependence of Asian emerging equity markets. Journal of Business Finance and Accounting, 22, 2, 281-288.

Hunter, J.E., & Coggin, T.D. (1990). An analysis of the diversification benefits from international equity investment. The Journal of Portfolio Management Fall, 17, 1, 33-36.

Hussain, F. & Qayyum, A. ( 2006). Stock Market Liberalisations in the South Asian Region. Pakistan Institute of Development Economics, (PIDE Working Papers, 6) Islamabad, Pakistan.

Ibrahim, M.H. (1999). Macroeconomic Variables and Stock Prices in Malaysia: An Empirical Analysis. Asian Economic Journal, 13, 2, 219-231.

International Trade Statistics Yearbooks, (Various Issues). UN Statistics Division, Department of Economic and Social Affairs.

Janakiramanan, S. & Lamba, A.S. (1998). An empirical examination of linkages between Pacific-Basin stock markets, Journal of International Financial Markets. Institutions and Money, 8, 155-173.

Jayasuriya, S. (2005). Stock market liberalisation and volatility in the presence of favourable market characteristics and institutions. Emerging Markets Review, 6, 170-191.

Johansen, S. & Juselius, K. (1990). Maximum likelihood estimation and inference on Cointegration - with application to the demand for money. Oxford Bulletin of Economics and Statistics, 52, 169–210.

Johansen, S. (1988). Statistical analysis of cointegrating vectors. Journal of Economic Dynamics and Control, 12, 231-254.

Johansen, S. (1991). Estimation and hypothesis testing of cointegration vestors in Gaussian vector autoregressive models. Econometrica, 59, 1551-1580.

Johnson, P. & Duberley, J. (2000) Understanding Management Research: An Introduction to Epistemology, Sage Publication Ltd. London.

Jolliffe, I.T., (1972). Discarding Variables in a Principal Component Analysis, In Artificial Data. Applied Statistics, 21, 160-173.

Jorion, P. (1985) International portfolio diversification with estimation risk. Journal of Business, 58, 259-77.

Joshi, P. (2011). Return and Volatility Spillovers among Asian Stock Markets. Sage Open Publication, 1-8.

Kaiser, H.F. (1960). The application of Electronic Computers to Factor Analysis. Educational and Psychological Measurement, 20, 141-151.

Kanas, A. (1998). Volatility Spillovers across Equity Markets: European Evidence. Applied Financial Economics, 8, 245-256.

Karolyi, G.A. & Stulz, R.M. (1996). Why do Markets Move Together? An Investigation of US-Japan Stock Return Comovements Using ADRs. Journal of Finance, 51, 951-986.

Kasa, K. (1992). Common stochastic trends in international stock markets. Journal of Monetary Economics, 29, 95-124.

Kassimatis, K. (2002). Financial liberalisation and stock market volatility in selected developing countries. Applied Financial Economics, 12. 389-394.

Kearney, C., & Patton, A.J. (2000). Multivariate GARCH Modeling of Exchange Rate Volatility Transmission in the European Monetary System, The Financial Review, 41, 29-48.

Khan, S.M. & Khan, Z.S. (2003). Asian Economic Integration: A perspective on South Asia. Journal of Asian Economics, 13. 767-785.

King, M. & Wadhwani, S. (1990). Transmission of volatility between stock markets. Review of Financial Studies 3, 5–33.

King, M. A., Sentana, E & Wadhwani, S.B. (1994). Volatility and links between national stock markets. Econometrica *62*, 901–33.

Kim, K-ho. (2003). Dollar exchange rate and stock price: evidence from multivariate cointegration and error correction model. Review of Financial Economics, 12, 3, 301–313.

Kim, E.H. & V. Singal. (2000). Stock market openings: Experience of emerging economies. Journal of Business 73, 25–66.

Korajczyk, R.A. (1996). A Measure of Stock Market Integration for Developed and Emerging Markets. The World Bank Economic Review, 10, 2, 267-289.

Koutmos, G. & Booth, G.G. (1995). Asymmetric Volatility Transmission in International Stock Markets. Journal of International Money and Finance, 14, 747-762.

Kuhn, T.S. (1970). The Structure of Scientific Revolutions. Chicago University Press.

Kwiatkowski, D., Phillips, P.C.B., Schmidt, P. & Shin. Y. (1992). Testing the Null Hypothesis of Stationarity against the Alternative of a Unit Root, Journal of Econometrics, 54, 159-178.

Kwon, C.S. & Shin, T.S. (1999). Cointegration and causality between macroeconomic variables and stock market returns. Global Finance Journal, 10, 1, 71-81.

Lamba, A.S. (2005). An analysis of the short- and long-run relationships between South Asian and developed equity markets. International Journal of Business, 10, 383-402.

Laopodis, N.T. (2004). Financial market liberalisation and stock market efficiency: evidence from the Athens stock exchange. Global Finance Journal, 15, 103-123.

Laopodis, N.T. (2011). Equity prices and macroeconomic fundamentals: International evidence. Journal of International Financial Markets, Institutions and Money 21, 247-276.

La Porta, R., Lopez-de-Silanes, F., Shleifer, A. & Vishny, R. (1998). Law and finance. Journal of Political Economy, 106, 1113–50.

Laughlin, R. (1995). Empirical Research in Accounting: Alternative Approaches and a Case for Middle Range Thinking. Accounting, Auditing and Accountability Journal, 8. 1. 63-87.

LeRoy, S.F. & Porter, R.D. (1981). The present value relation: Tests based on implied variance bounds. Econometrica, 49, 555-574.

Lessard, D.R. (1973). International portfolio diversification: a multivariate analysis for a group of Latin American countries. Journal of Finance, 28. 619-33.

Lessard, D.R. (1976). World, Country, and Industry Relationships in Equity Returns: Implications for Risk Reduction through International Diversification. Financial Analysts Journal January/February, 32-38.

Levy, H. & Sarnat, M. (1970). International diversification of investment portfolios. American Economic Review, 60, 668-675.

Li, H. (2007). International linkages of the Chinese stock exchanges: A multivariate GARCH analysis. Applied Financial Economics, 17, 285-295.

Li, H. & Majerowska, E. (2008). Testing stock market linkages for Poland and Hungary: A multivariate GARCH approach. Research in International Business and Finance 22, 247–266.

Li, K., Sarkar, A. & Wang, Z. (2003). Diversification benefits of emerging markets subject to portfolio constraints, Journal of Empirical Finance 10, 57-80.

Lin, W., Engle, R.F. & Ito, T. (1994). Do bulls and bears move across borders? International transmission of stock returns and volatility. Review of Financial Studies, 7, 507-538.

Lintner, J. (1965). The Valuation of Risky Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets. Review of Economics and Statistics, 47, 1, 13-37.

Liu, X., Song, H. & Romilly, P. (1997). Are Chinese stock markets efficient? A cointegration and causality analysis. Applied Economics Letters, 4, 511-515.

Liu, Y.A. & Pan, M.S. (1997). Mean and Volatility Spillover Effects in the U.S. and Pacific–Basin Stock Markets. Multinational Finance Journal, 1, 1, 47–62.

MacDonald, R. & Power, D.M. (1994). An alternative test of stock market efficiency: an analysis of UK share price data. British Review of Economic Issues, 16, 33-54.

MacKinnon, J.G., Haugh, A. & Michelis, L. (1999). Numerical Distribution Functions of Likelihood Ratio Tests for Cointegration. Journal of Applied Econometrics, 14, 563-577.

Maghayereh, A. (2006). Regional integration of stock markets in MENA countries. Journal of Emerging Market Finance, 5, 59-94.

Mahmood, M. W. & Dinniah, M. N. (2009). Stock Returns and Macroeconomics Variables: Evidence from Six Asian-Pacific Countries. International Research Journal of Finance and Economic, 30, 154-164.

Malik, F. & Ewing, B.T. (2009). Volatility transmission between oil prices and equity sector returns. International Review of Financial Analysis, 18, 95-100.

Malik, F. & Hammoudeh, S. (2007). Shock and volatility transmission in the oil, US and Gulf equity markets. International Review of Economics and Finance, 16, 357−368.

Mandelbrot, B. (1963). The Variation of Certain Speculative Prices. The Journal of Business, 36, 4, 394-419.

Markowitz, H. (1952). Portfolio Selection. Journal of Finance, 7.77–91.

Masih, A.M.M. & Masih, R. (1999). Are Asian stock market fluctuations due mainly to intra-regional contagion effects? Evidence based on Asian emerging stock markets. Pacific-Basin Finance Journal, 7, 251-282.

Masih, A.M.M. & Masih, R. (2002). Propagative causal price transmission among international stock markets: evidence from the pre- and post-globalisation period. Global Finance Journal, 13, 63-91.

Masih, R. & Masih, A.M.M. (2004). Common stochastic trends and the dynamic linkages driving European stock markets: evidence from pre- and post- October 1987 crash eras. The European Journal of Finance, 10, 81-104.

Maysami, R.C., Howe, L.C. & Hamzah, M.A. (2004). Relationship between Macroeconomic Variables and Stock Market Indices: Cointegration Evidence from Stock Exchange of Singapore's All-S Sector Indices. Journal Pengurusan, 24, 47-77.

Meric, I., Kim, S., Kim, J.H. & Meric, G. (2008). Co-Movements of U.S., U.K., and Asian Stock Markets before and After September 11, 2001. Journal of Money, Investment and Banking 3, 47-57.

Middleton, C.A.J. (2006). An Analysis of Equity Investment in the Emerging stock Markets of Central and Eastern Europe, Unpublished PhD Thesis, School of Accounting and Finance, University of Dundee, UK.

Middleton, C.A.J., Fifield, S.G.M. & Power, D.M. (2007). Investment in Central and Eastern European equities: an investigation of the practices and viewpoints of practitioners. Studies in Economics and Finance 24. 13–31.

Middleton, C.A.J., Fifield, S.G.M. & Power, D.M. (2008). An investigation of the benefits of portfolio investment in Central and Eastern European stock markets. Research in International Business and Finance, 22. 162–174.

Mobarek, A., Mollah, A. S. & Bhuyan, R. (2008). Market Efficiency in Emerging Stock Markets: Evidence from Bangladesh, Journal of Emerging Market Finance, 7, 1, 17-41.

Mobius, M. (1994). The Investor's Guide to Emerging Markets. FT Pitman Publishers, London.

Modigliani, F. & Cohn, R.A. (1979). Inflation, Rational Valuation and the Market. Financial Analysts Journal, 35,2,24-44.

Mossin, J. (1966). Equilibrium in a Capital Asset Market, Econometrica, 768-783.

Mukherjee K.N. & Mishra, R.K. (2010). Stock market integration and volatility spillover: India and its major Asian counterparts. Research in International Business and Finance, 24, 235-252.

Mukherjee, T. K. & Naka, A. (1995). Dynamic relations between macroeconomic variables and the Japanese stock market: an application of a vector error correction model. The Journal of Financial Research 18, 2, 223-237.

Narayan, P., Smyth, R. & Nandha, M. (2004). Interdependence and dynamic linkages between the emerging stock markets of South Asia. Accounting and Finance, 44, 419-439.

Nasseh, A. & Strauss, J. (2000). Stock prices and domestic and international macroeconomic activity: a cointegration approach. The Quarterly Review of Economics and Finance, 40, 229–245.

Ng, A. (2000). Volatility spillover effects from Japan and the US to the Pacific-Basin. Journal of International Money and Finance, 19, 207-233.

Nikkinen, J., Omran, M.M. Sahlstrom, P. & Aijo, J. (2008). Stock return and volatility following the September 11 attacks: Evidence from 53 equity markets. International Review of Financial Analysis, 17, 27-46.

Osterwald-Lenum, M. (1992). A note with quantiles of the asymptotic distribution of the ML cointegration rank test statistics. Oxford Bulletin of Economics and Statistics, 54, 461-472.

Park, J. & Fatemi, A. (1993). The linkages between the equity markets of Pacific-Basin countries and those of the US, UK, and Japan: a vector auto regression analysis. Global Finance Journal 4, 49-64.

Patra, T. & Poshakwale, S. (2006). Economic variables and stock market returns: evidence from the Athens stock exchange. Applied Financial Economics, 16: 13, 993-1005.

Pearson, K. (1901). On Lines and Planes of Closest Fit to Systems of Points in Space. Phil., May, 2, 559-572.

Pesaran, H.H. & Shin, Y. (1998). Generalized impulse response analysis in linear multivariate models. Economics Letters 58, 17–29.

Phengpis, C. & Apilado, V.P. (2004). Economic interdependence and common stochastic trends: A comparative analysis between EMU and non-EMU stock markets. International Review of Financial Analysis, 13, 245-263.

Phillips, P.C.B. & Perron, P. (1988). Testing for a unit root in time series regression. Biometrica, 75, 335-346.

Phylaktis, K. & Ravazzolo, F. (2005). Stock market linkages in emerging markets: implications for international portfolio diversification. Journal of International Financial Markets, Institutions and Money, 15, 91-106.

Pike, R. & Neale, B. (2006). Corporate Finance and Investment. FT, Pearson Education, 5th Edition.

Poon, S. & S.J. Taylor, S.J. (1991). Macroeconomic Factors and the UK Stock Market. Journal of Business Finance & Accounting, 18, 5, 619-636.

Poon, S., Taylor, S.J. & Ward, C.W.R. (1992). Portfolio diversification: a pictorial analysis of the UK stock market. Journal of Business Finance and Accounting, 19, 87-102.

Rapacha, D.E.,Woharb, M.E. & Rangvid, J. (2005). Macro variables and international stock return predictability. International Journal of Forecasting, 21, 137– 166,

Roca, E. (1999). Short-term and long-term price linkages between the equity markets of Australia and its major trading partners. Applied Financial Economics, 9, 5, 501-511.

Ross, S.A. (1976). The Arbitrage Theory of Capital Asset Pricing. Journal of Economic Theory, 13, 341-360.

Runkle, D. E. (1987) Vector Autoregressions and Reality, Journal of Business and Economic Statistics 5, 4, 437-442.

Ryan, B., Scapens, R. & Theobald, M. (2002). Research Method and Methodology in Finance and Accounting, London: Thomson.

Samuels, J.M., Wilkes, F.M. & Brayshaw, R.E. (1995). Management of Company Finance. London, Chapman & Hall, 6th Edition.

Samuelson, P.A. (1965). Proof that properly anticipated prices fluctuate randomly. Industrial Management Review, 6, 2, 41- 49.

Saunders, M., Lewis, P. & Thornhill, A. (2007). Research Methods for Business Students, Prentice Hall.

Scheicher, M. (2001). The comovements of stock markets in Hungary, Poland and the Czech Republic. International Journal of Finance and Economics, 6, 27-39.

Sharpe, W.F. (1964). Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk. Journal of Finance, 19, 3, 425-442.

Sharif, F. (2012). Pakistan eases stock market tax rules to support activity, Bloomberg.com, Accessed on October, 18, 2012.

Shiller, R.J. (1981). Do stock prices move too much to be justified by subsequent changes in dividends? American Economic Review, 71, 421- 436.

Sing, T.F. & Low, S.H.Y. (2000). The Inflation-Hedging Characteristics of Real Estate and Financial Assets in Singapore. Journal of Real Estate Portfolio Management. 6, 4, 373-385.

Singh, A. (1997). Financial Liberalisation, Stock markets and Economic Development. The Economic Journal, 107. 771-782.

Singh, A. & Weisse, B.A. (1998). Emerging Stock Markets, Portfolio Capital Flows and Long-term Economic Growth: Micro and Macroeconomic Perspectives. World Development, 26. 607-622.

Singh, P., Kumar, B. & Pandey, A. (2010). Price and volatility spillovers across North American, European and Asian stock markets. International Review of Financial Analysis, 19, 55–64.

Smith, R. & Nandha, M. (2003). Bivariate Causality between Exchange Rates and Stock Prices in South Asia. Applied Economics Letter 10, 699–704.

Sohail, N & Hussain, Z. (2009). Long-run and Short-run relationships between Macroeconomic variables and Stock Prices in Pakistan: The case of Lahore Stock Exchange. Pakistan Economic and Social Review, 47, 2, 183-198.

Sok-Gee, C., Karim, M.Z.A. & Karim, M.Z.A. (2010). Volatility Spillovers of the Major Stock Markets in ASEAN-5 with the U.S. and Japanese Stock Markets. International Research Journal of Finance and Economics, 44, 156-168.

Solaiman, S.M. (2006). Recent Reforms and the Development of the Securities Market in Bangladesh : A Critique. Journal of Asian and African Studies, 41, 3, 195-228.

Solnik, B.H. (1974). Why not diversify internationally rather than domestically? Financial Analysts Journal, 30. 48–54.

Solnik, B.H. (1975). The advantages of domestic and international diversification. International Capital Markets, (Eds.) E. J. Elton and M. J. Gruber. 165-176.

Solnik, B., Cyril, B. & Yann, L.F. (1996). International market correlation and volatility. Financial Analysts Journal, 52, 5, 17-34.

Sorensen, E., Mezrich, J. & Thum, C. (1989). The Salomon Brothers US Stock Risk Attribute Model. Salomon Brothers, October.

Sorensen, E., Salomon, R.S., Davenport., C. & Fiore, M. (1989). Risk Analysis: The Effect of Key Macroeconomic and Market factors on Portfolio Returns. Salomon Brothers, November.

South Asian Financial Market Review, (2010). A Publication of the South Asian Federation of Exchanges.

Speidell, L.S. & Sappenfield, R. (1992). Global diversification in a shrinking world. Journal of Portfolio Management. 18. 57–67.

Standards and Poor's. (2009). Global Stock Markets Factbook.

Standards and Poor's. (2010). Global Stock Markets Factbook.

Standards and Poor's. (2011). Global Stock Markets Factbook.

Suleman, M.T. (2012). Stock market reaction to terrorist attacks: Empirical evidence from a front line state. Australian Accounting Business and Finance Journal, 6, 97-110.

Syriopoulos, T. (2004). International portfolio diversification to Central European stock markets. Applied Financial Economics, 14, 1253-1268.

Syriopoulos, T. (2007). Dynamic linkages between emerging European and developed stock markets: Has the EMU any impact? International Review of Financial Analysis, 16, 41-60.

Tay, N.S.P. & Zhu, Z. (2000). Correlations in Returns and Volatilities in Pacific-Rim Stock Markets. Open Economies Review, 11, 27–47.

Taylor, M.P. & Tonks, I. (1989). The internationalisation of stock markets and the abolition of UK exchange controls. Review of Economics and Statistics, 71, 332-336.

Tesar, L.T. & Werner, I.M. (1995). Home bias and high turnover, Journal of International Money and Finance, 14. 467–492.

Theodossiou, P. & Lee, U. (1993). Mean and Volatility Spillovers Across Major National Stock Markets: Further Empirical Evidence. Journal of Financial Research, 16, 337-350.

Wang, Y., Gunasekarage, A. & Power, D.M. (2005). Return and Volatility Spillovers from Developed to Emerging Capital Markets: The Case of South Asia. Contemporary Studies in Economics and Financial Analysis, 86, 139-166.

Wang, Z., Yang, J. & Bessler, D.A. (2003). Financial crisis and African stock market integration. Applied Economics Letters, 10, 527–533.

Wilcox, J.W. (1992). Taming Frontier Markets. Journal of Portfolio Management, 19. 51-55.

Wilks, D.S. (2011). Statistical Methods in the Atmospheric Sciences, 3rd Edition: International Geophysics Series, 100, Academic Press.

Wongbangpo, P. & Sharma, S.C. (2002). Stock Market and Macroeconomic fundamentals dynamic interactions: ASEAN-5 countries. Journal of Asian Economics, 13, 27-51.

Worthington, A. & Higgs, H. (2004). Transmission of equity returns and volatility in Asian developed and emerging markets: A multivariate GARCH analysis. International Journal of Finance and Economics, 9, 71-80.

Yang, J., Kolari, J.W. & Min, I. (2003). Stock market integration and financial crises: the case of Asia. Applied Financial Economics, 13, 477-486.

Yuhn, K.H. (1997). Financial integration and market efficiency: some international evidence from cointegration tests. International Economic Journal, 11, 103-115.

Zaidi, E. (2010). Political instability, law and order to hit economy in '10'. Daily the Nation, January 1, 2010.

Zhou, T.T., Gunasekarage, A. & Power, D.M. (2005). Do Real Estate Assets Hedge Inflation Better Than Financial Assets? Some New Zealand Evidence. Briefings in Real Estate Finance, 5, 39–46.

http://data.worldbank.org/data/wdi2010. Accessed in 2010 and 2012.

http://www.asiaecon.org/special-articles/read-sp/12556. Accessed on October, 24,2012.